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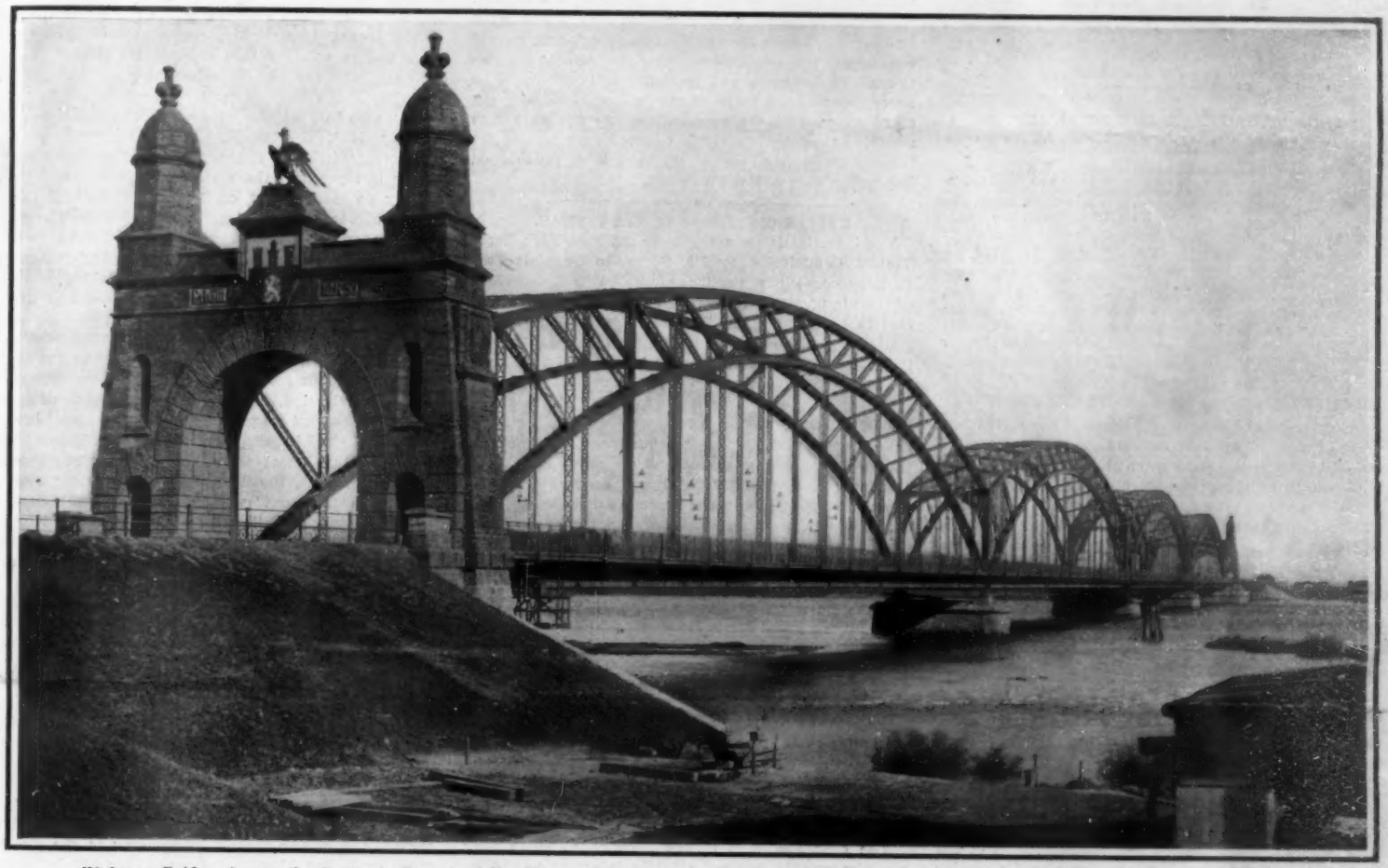
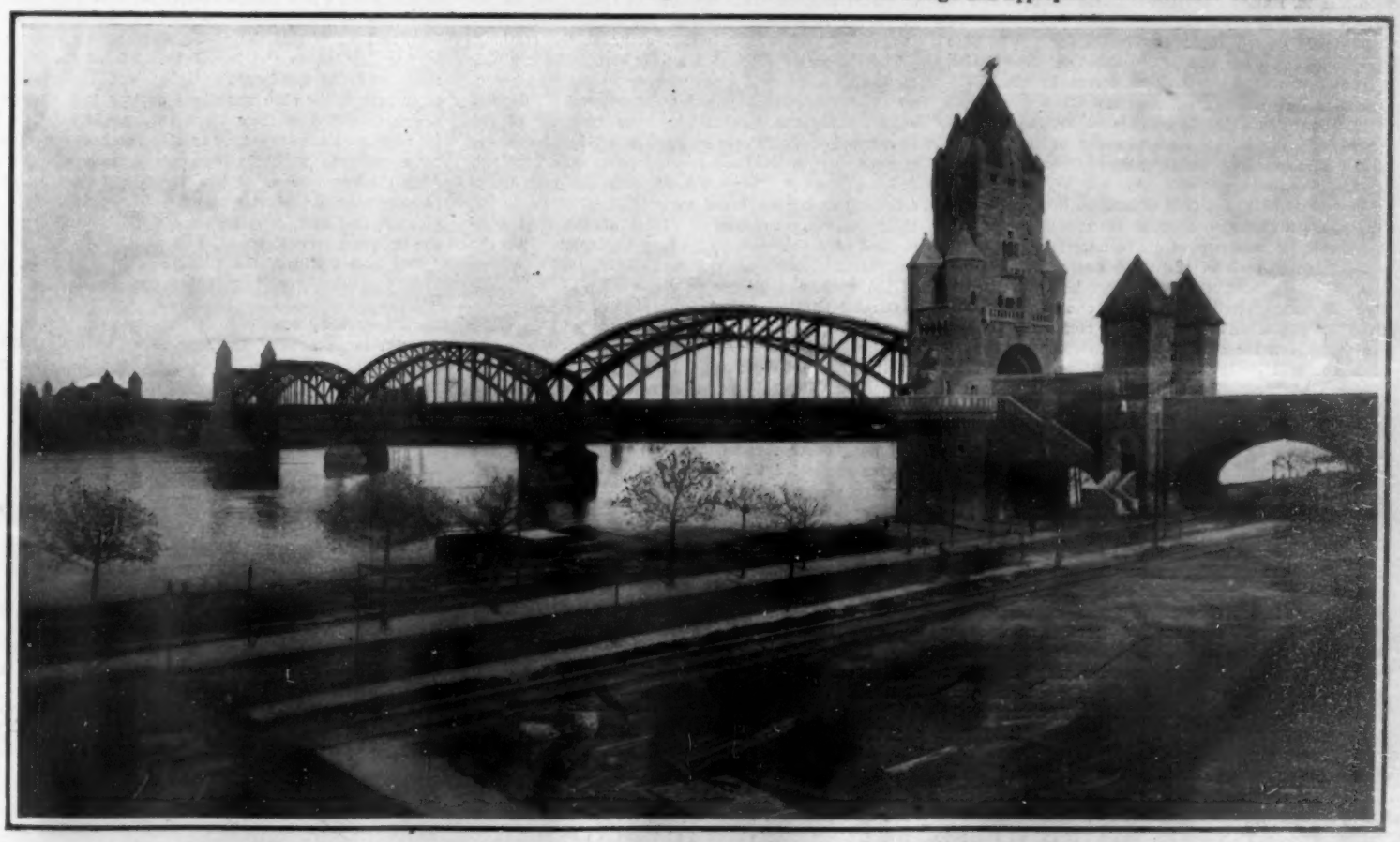


Highway Bridge Across the Southern Branch of the Elbe at Harburg. An Instance of Graceful Design and Appropriate Architectural Treatment.



Railway Bridge Across the Rhine at Mainz. The Abutments Are Designed to Express the Strategical Importance of the Location in History.

SOME NOTABLE GERMAN BRIDGES.—[See page 151.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, AUGUST 31, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

COMBINED RECIPROCATING AND TURBINE ENGINES.

Unquestionably the greatest defect of the steam turbine, when used for marine work, is the fact that it cannot be reversed. Many attempts have been, and are now being, made to remedy this; but, as far as we know, a practical reversing turbine has yet to be built. The present practice is to provide two reversing turbines of limited power, usually fitted on the same shafts as the low-pressure turbines, which, when the ship is running ahead, revolve idly *in vacuo*. To reverse, the steam is shut off from the ahead turbines and admitted to the auxiliary reversing turbines. This arrangement has the double disadvantage that a portion only of the motive power is available for backing, and a considerable section of the plant is idle for the greater part of the time. Furthermore, the addition of reversing turbines calls for additional longitudinal space in the ship; with the result that the floor space occupied by marine turbine engines is actually greater than that occupied by reciprocating engines of the same horse-power. With a view to obtaining all the advantages of a great range of expansion and a high vacuum, which are marked characteristics of the turbine, the White Star Company has placed an order with Messrs. Harland & Wolff to build the first of two large steamers for the transatlantic trade, which are to be driven by a combined reciprocating and turbine engine plant. Power will be developed on three shafts, the outer two of which will be driven by quadruple-expansion reciprocating engines, and the central shaft by a low-pressure turbine, operated by the exhaust steam from the low-pressure cylinder of the reciprocating engines. For going astern the reciprocating engines will be used, while in ordinary service all three engines will be driven in combination.

Further advantages of this installation are that there will be separate steam connections from the boiler room to each of the three engines, so that in case of disablement, the vessel can be driven under the reciprocating engines or even by one of them alone, or by the steam turbine alone, live steam in this last case being fed direct to the turbine. The range of expansion will be increased, since it will be possible to use a higher pressure steam in the reciprocating engines than is found to be economical for steam turbines; while, on the other hand, the turbine end of the expansion can be carried down very much lower and with a higher vacuum than is possible in the reciprocating engine alone.

UNITED STATES AND BRITISH GUNNERY.

There can be little question that the close attention which has been paid, both in our own and in the British navy, to the improvement of gunnery, has placed these two nations far to the front in accuracy of marksmanship. The remarkable results attained by both navies at the target, as published from time to time, have raised the question as to which navy has achieved the highest record. A daily contemporary recently published some figures from Washington giving a few of the best records obtained in our Atlantic fleet. The most accurate shooting appears to have been done with the 6-inch rapid-fire gun; one gunner on the armored cruiser "Maryland" having made 11 shots and 11 hits in one minute. A gun of the same caliber was fired on the battleship "Ohio" at the rate of 10.8 shots a minute, and made a perfect score. A similar gun on the battleship "Maine" is credited with a perfect score at the rate of 10.4 shots a minute, while the battleship "Missouri's" best record is 10.3 shots a minute. The smaller guns have done even better. A 3-pounder on the battleship "Virginia" fired 20 shots with 20 hits in 75 seconds, while another 3-pounder fired 10 shots with 10 hits in 22½ seconds.

The latest figures available from the British navy are those of results obtained during gunnery practice at Wei-Hai-Wei, China, when three 6-inch guns on the armored cruiser "King Alfred" fired 38 rounds in one minute, scoring 37 hits, of which 28 were bull's eyes. One of these three guns made a bull's eye every time in 11 shots. The same ship made almost as good practice with her two 9.2-inch guns, one of which fired 10 rounds in one minute, making 10 hits with eight bull's eyes, while the other fired 9 rounds in a minute, all of which found a target, and 7 of which were bull's eyes. The range in all cases was approximately one mile. To establish satisfactory comparison between the American and British results, it would be necessary to have more complete data, including the exact range and the speed at which the ship was steaming past the target. In any case, the results are truly surprising. They would have been pronounced impossible only a few years ago.

HEALTH CONDITIONS IN THE SUBWAY.

The investigation conducted for the New York Rapid Transit Commission by Dr. Soper, to determine the sanitary conditions, particularly as regards the effect of the air upon the health of employees, has materialized in two reports, in the first of which the author states that although the Subway air is disagreeable, it is not harmful except for the presence of iron dust. In the second of the two reports, dealing with the effect of iron dust upon the employees, it is stated that a sufficient number of persons were subjected to physical examination to determine the condition of the average employee. A careful search was made for evidences of diseases of the lungs, such as are common among people engaged in occupations where dust is present. An examination of the air showed the presence of a large amount of iron dust, and of various kinds of fragments due to the wear and tear of the Subway and the abrasion of the clothing of the passengers. From the samples taken it was estimated that in every month 25 tons of iron and steel are ground off the rails, brake-shoes, and wheels, on the 21 miles of the Subway. Much of this material is in such large pieces that it falls immediately to the track, and adheres to the surface of the ballast or ties.

Among the conclusions reached by Dr. Soper are the following: The air of the Subway as determined by analysis and careful studies of the health of the men is not injurious, the most objectionable feature being the dust, made up chiefly of angular particles of iron.

The odor and heat of the Subway, although they are disagreeable, are not actually injurious to health, the most objectionable atmospheric conditions, as far as health is concerned, being the strong drafts and changes of temperature which occur at the stations.

The employees submitted by the company for physical examination were a particularly robust lot of men, who had evidently been carefully selected. This was explained by the fact that a large majority of the men had previously been engaged in railroading, where the capacity to do hard manual labor was required. Judging from the accounts given by the men themselves, they have suffered very little sickness during their Subway employment. Most of the men complained of drowsiness, which may be explained by the comparative darkness of the Subway, the monotony of the work, and fatigue to the eye.

Careful physical examination showed that an excessive amount of dry pleurisy without pain or other physical discomfort existed among the men, the proportion being 53 per cent among the employees, as compared with 14½ per cent among persons not engaged in Subway work. Congestion and inflammation of the upper air passages were prevalent.

Among other recommendations made in the report, it was suggested that while the dust does not prove to have produced harmful results, sanitary conditions require that it should be prevented as far as practical from getting into the air. To this end, sand and sawdust should not be scattered for cleaning purposes; sweeping and cleaning should be done in accordance with the recommendations of the Advisory Board of the Department of Health; and investigations should be made to determine whether it is feasible to reduce or collect much of the iron dust. Lastly, the city ordinance against spitting should be enforced to the letter.

FULTON THE FATHER OF COMMERCIAL STEAMBOAT NAVIGATION.

Although the celebration of the centennial of Fulton's successful inauguration of steam navigation will not take place for another year, it is fitting that some anticipatory tribute should at this time be paid to the event, and to the remarkable man to whose faith, farsightedness, and indomitable will that event was due. The claim of Fulton to be considered the father of steam navigation stands or falls with the claims of pretty nearly every inventor of the first rank in his own field of endeavor. The SCIENTIFIC AMERICAN has always held that, if some individual must be chosen from among the many who are associated in the development of any great invention, whose name it is to bear in the years to come, the choice should fall upon the man who gathers together the unrelated and more or less fragmentary work of his predecessors, stamps it with his own inventive originality, and gives it to the world in practical working form. It is upon these principles of selection that Bessemer is known as the father of the modern steel industry; Edison, of the electric light; Westinghouse, of the air brake; Marconi, of wireless telegraphy; Sprague, of the trolley car; and Parsons, of the steam turbine.

With equal impartiality, posterity has agreed to name Fulton as the father of modern steamboat navigation. In doing so, there has been no intentional slighting of the work of earlier inventors; of William Henry, who in 1763 was at work on the problem, and actually built a steamboat propelled with paddle wheels; of Fitch and Rumsey, who did excellent work in the last years of the eighteenth century, and last, and by no means least, of Stevens. Indeed, if there is any one inventor in America who, on the strength of his practical achievements, presses Fulton rather closely for the claim to be considered the father of steam navigation, it is Stevens, who in 1804 ran a steam yawl from the Battery to Hoboken, and three years later ran the "Phœnix" to New Brunswick, and in less than a year after the trip of the "Clermont" to Albany and back, sent the same "Phœnix" to Philadelphia by sea, thus securing the credit for inaugurating deep-sea navigation. However, the consensus of opinion on the part of those who have made careful investigation of the historical facts, accords to Robert Fulton the distinction of placing on a regular route, running on schedule, the first practical passenger steamship. The "Clermont" was no mere inventor's model. It was a stanchly-built craft, designed for a special purpose; and at its very first venture, it achieved what, considering all the conditions, must be forever regarded as a brilliant success.

The most authentic record of the "Clermont" is the model which is housed in the National Museum at Washington. Even a cursory inspection is sufficient to show to the naval architect how strong an influence Fulton's craft has had on the subsequent designs of Hudson River steamboats. In it we find the typical flat bottom and shoal hull; the wide guards, and even the system of trussing which has remained as an integral and important structural feature of these boats for nearly half a century. The "hog frame" was present in the "Clermont" in the shape of two trusses extending through the vessel abreast of the boiler, engine, and paddle wheels. According to the figures given by Fulton himself, the vessel was 150 feet long, 13 feet wide, 7 feet deep, and drew 28 inches of water. The plan of accommodation shows a kitchen in the bow, and aft of this the men's room, with a companionway leading to the fore deck. Aft of the boiler room was the gentlemen's cabin; and the extreme after part of the ship was given up to a ladies' cabin, access to the deck from these two cabins being had by means of a companionway situated between them in a separate vestibule, entered by separate doors from the two cabins. It is evident that, even in this pioneer boat, an effort was made to provide suitable privacy, and such conveniences as the limited size of the little craft could afford.

The initial trip of the "Clermont" was made from Paulus Hook ferry, now known as Barclay Street. That Robert Fulton himself must even at that time have been fully conscious of the historical and commercial importance of the feat which he had at last accomplished, is shown by a letter which he wrote to the editor of the American Citizen, the text of which is as follows: "Sir: I arrived this afternoon, at four o'clock, in the steamboat from Albany. As the success of my experiment gives me great hopes that such boats may be rendered of great importance to my country, to prevent erroneous opinions and give some satisfaction to the friends of useful improvements, you will have the goodness to publish the following statement of facts: I left New York on Monday at one o'clock, and arrived at Clermont, the seat of Chancellor Livingston, at one o'clock on Tuesday—time, twenty-four hours; distance, one hundred and ten miles. On Wednesday, I departed from the Chancellor's at nine in the morning, and arrived at Albany at five in the afternoon—distance, forty miles; time, eight hours. The sum is one hundred and fifty miles in thirty-two hours, equal to near five miles an hour. On Thursday, at nine o'clock in the morning, I left Albany, and arrived at the Chancellor's at six in the evening; I started from thence at seven, and arrived at New York at four in the afternoon, one hundred and fifty miles, equal to five miles an hour. Throughout my whole way, both going and returning, the wind was ahead; no advantage could be derived from my sails: the whole has, therefore, been performed by the power of the steam-engine."

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

Daniel's comet, which has been visible to the naked eye in the morning sky for some weeks past, is still increasing in brightness, and has become a conspicuous object, much surpassing anything of the sort that we have had the chance to see in the last fifteen years.

At the date of writing, its head is almost of the second magnitude, and its tail is fully ten degrees long, and is growing rapidly. For the next few weeks it will be a fine sight, though the neighborhood of the moon has interfered with it somewhat during the latter part of August. But early in September she gets out of the way, and at this time the comet will probably appear to great advantage, as it will be just past perihelion, when coments' tails usually reach their greatest development.

The comet has already passed its nearest approach to the earth—70 million miles—which was reached on August 1, when it was 85 million miles from the sun, but it will not be ne rest to the sun till September 4, when its distance will be 48 million miles. At this time it will be about 100 million miles from us, but the resulting ioss of brightness will be more than balanced by the gain due to its approach to the sun.

At the date of writing the comet is in Gemini, in R. A. 7h. 15m., and about six degrees south of the ecliptic. It is moving rapidly eastward, nearly parallel to the latter, and its elongation from the sun is diminishing, but it will remain well visible before dawn till after perihelion passage.

It is so conspicuous that no special directions for finding it are really necessary. All that is needful is to get up about half past three in the morning, and look from any window that commands an unobstructed view of the eastern sky. The comet will be below and to the left of Orion (or, later on, below Jupiter) and can be known at a glance by the long tail, sweeping upward to the right. It is well worth getting up to see at present, and will probably be better yet early in September.

Toward the end of the month it begins to recede rapidly from both earth and sun, and it will not remain a naked-eye object for more than a few weeks, though it should be visible telescopically for many months to come.

It is natural that the appearance of this fine comet should lead us to ask some questions about comets in general. What they look like anyone can now find out for himself by getting up early enough—a bright star-like point or *nucleus*, surrounded by a hazy light called the *coma*, which extends on one side into a long beam of light, gradually growing fainter, called the *tail*. This description applies, of course, to the bright comets; the faint telescopic ones are often mere clouds of luminous haze, with neither nucleus nor tail.

The orbits of comets, in accordance with the law of gravitation, are conic sections. About four-fifths of them have very nearly, if not exactly, the form of a parabola—they come toward the sun from a very great distance, swing round it, and recede again in the same direction from which they came, not to return for an incalculably long time. Almost all the remainder of the comets move in elliptic orbits, usually much elongated, and return regularly to the sun at intervals varying from three years (in one case) to many thousands. A very few appear to have hyperbolic orbits, going off into space, never to return, in a slightly different direction from that whence they came.

It takes a large number of observations and a deal of laborious calculation to determine with accuracy to which of these classes a given comet belongs. At the start, astronomers always assume that a newly-discovered comet is moving in a parabola, for in all cases this will enable us to predict their motions with sufficient accuracy to find them when we wish to observe them further, and then our later observations can be used to determine just how they are moving.

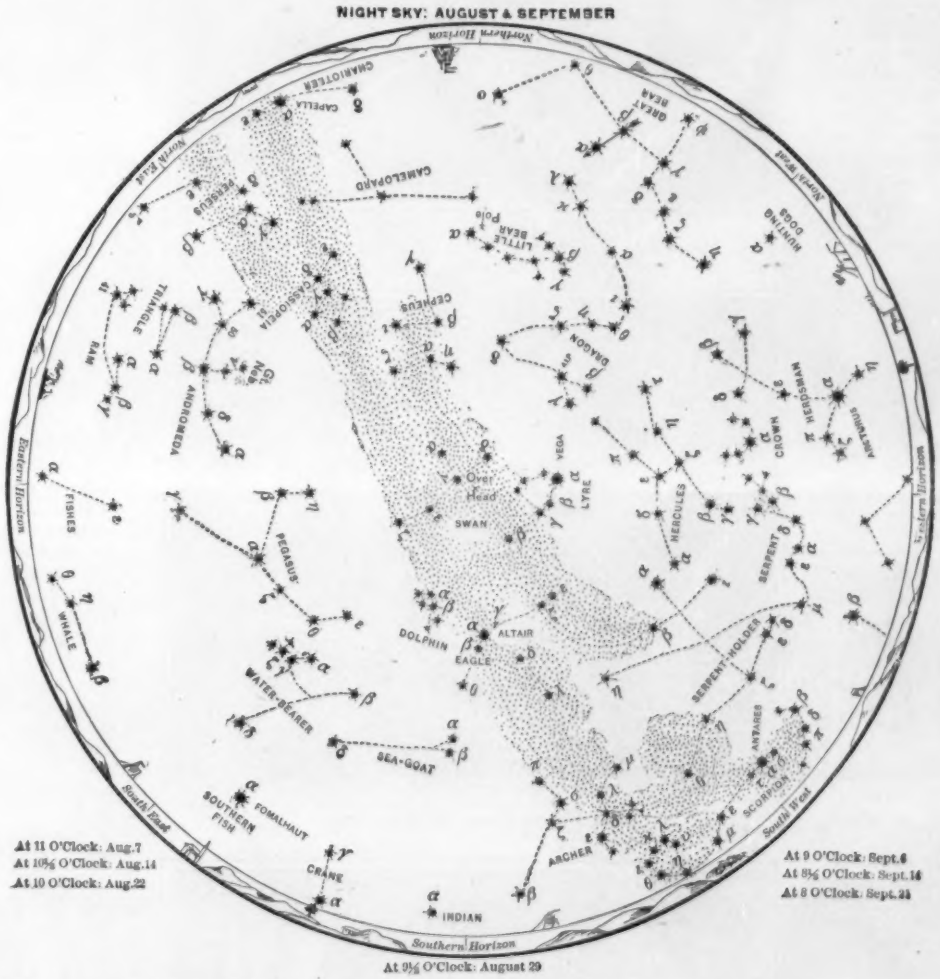
In the present case it is too soon to say what the exact character of the comet's orbit is. We can, however, be sure that it is not of short period, for so conspicuous a body would certainly have been seen at an earlier return to the sun, if it had made one in recent years.

Of the physical characteristics of comets, and the explanation of the formation of their tails, we will speak next month.

THE HEAVENS.

Our map shows the principal constellations of the evening skies. The Lyre and the Swan are overhead. South of them are the Eagle, with the bright star Altair and the little Dolphin. Low in the south and southwest are the Scorpion, with the bright red star Antares, and the Archer, which now contains the still brighter red planet Mars. In the southeast are the Sea Goat and the Water Bearer, which now bears Saturn as well within its limits. Below them is the lovely bright star Fomalhaut, in the Southern Fish.

Pegasus and Andromeda are in the east, with the Ram, the Fishes, and the Whale rising below them. Perseus and the Charioteer are just rising farther north. Cepheus and Cassiopeia are above the pole on the right, and the Little Bear and the Dragon on the left, with the Great Bear below them. Hercules and the Herdsman (Boötes) and the Serpent and Serpent Bearer fill the western sky and complete our list.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed; fourth magnitude (a few), four-pointed; fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

THE PLANETS.

Mercury is in conjunction with the sun on the 6th, and is not well placed for observation this month. Venus is likewise in conjunction with the sun (changing as does Mercury from a morning to an evening star) and is unobservable.

Mars is in Sagittarius, and comes to the meridian about 7:30 P. M. in the middle of the month. He is less than half as bright as he was in July, but is still conspicuous.

Jupiter is in Cancer, and rises at about 2 A. M. in the middle of the month.

Saturn is in Aquarius, and comes to opposition on the 17th, being visible all night long. He is an exceedingly interesting object in large telescopes at present, for his rings are turned edgewise to us, and appear as a very fine line of light, upon which the satellites, if they are near the planet, appear like beads on a fine wire. With small telescopes nothing of this can be seen, and the planet appears without appendages, as it did when it puzzled Galileo three centuries ago. Uranus is in Sagittarius, and comes to the meridian about 7 P. M. on the 15th. Neptune is in Gemini, observable in the early morning.

THE MOON.

New moon occurs at 4 P. M. on the 7th, first quarter at 11 P. M. on the 14th, full moon at 4 P. M. on the 21st, and last quarter at 6 A. M. on the 29th. The moon is nearest us on the 18th, and farthest off on the 2d and the 30th. She is in conjunction with Neptune on the 2d, Jupiter on the 4th, Venus and Mercury on the 7th, Uranus and Mars on the 16th, Saturn on the 21st, and Neptune once more on the 30th. At midnight on the 23d the sun crosses the celestial equator, and enters the sign of Libra, and in almanac phrase, "autumn commences."

Princeton Observatory, N. J.

THE COMPETITION FOR THE SCIENTIFIC AMERICAN FLYING MACHINE TROPHY.

On account of lack of sufficient time in which to complete their machines, several intending competitors for the silver trophy offered by this journal for the first public flight of one kilometer (six-tenths of a mile) to be made in this country by a heavier-than-air flying machine, have requested that the date of the closing of entries be made later than September 1, which was the date set. We have conferred with the Aero Club of America and made arrangements to have the entries held open until September 11, or three days before the contest, which is to occur at the Jamestown Exposition on Saturday, September 14. This will give intending competitors another fortnight in which to complete their machines before making formal entry, and we hope that it may serve to bring out still other inventors who have been holding their machines in abeyance. The entries must be made in writing, and must be received by the secretary of the Aero Club of America at the club rooms, 12 East 12th Street, not later than September 10. With each entry there must be given a description of the machine, such as its dimensions, weight, supporting surface, horse-power, and description of motor, diameter and pitch of propellers, etc. Any inventor who intends to compete can obtain further information and entry blanks by writing to this office or to the secretary of the Aero Club. The trophy is nearing completion, and, when finished, it will be exhibited both in New York city and at the Exposition.

An interesting heliographic experiment will shortly be made at the suggestion of several captains of the North German Lloyd on the fireship "Weser." Daily experience shows that sunlight reflected from glass plates will make houses and the like visible to great distances, which without this luminous reflex would be difficult and sometimes impossible. Starting from this principle, the promoters of the experiment in question will place at the top of the fireship a polished glass body comprising a number of plane polyhedral surfaces. The apparatus itself is very simple in construction, comprising a frame about two feet in diameter, in which plane glass plates coated with mercury are fitted, it being left to chance when some glass surface will be struck by a sun ray. This apparatus will work as a heliograph in a low mist or in hazy weather for many miles, facilitating to a high extent the locating of the fireship. In case of satisfactory results, the apparatus will be fitted also on other fireships, etc.

Packing for Steam Conductors.—Asbestos 40 per cent, slag wool 20 per cent, wood cellulose 20 per cent, long fibers of hemp rope 20 per cent. Ropes are ground to half stuff, above quantities mixed, ground, poured into plates, saturated with water glass, and after drying cut into rings or slabs.

"BLACK ART" REDIVIVUS.

From time to time various identical stage illusions crop up with a regularity that seems to be dependent only upon the bad memory of the show-goer. We have recently had a revival of the mysterious and uncanny "black art" in this country in the "Wizard of Oz," and in London, under the direction of Mr. J. N. Maskelyne, the well-known magician, "black art" has always lent itself to spiritualistic purposes as in the present case. When the curtain rises the stage is empty. Mr. Maskelyne enters with a friend, who is introduced to provide the usual scene associated with spirit mediums. The actor in the course of a few minutes appears to go into a trance, and almost immediately a filmy cloud of vapor is seen to be issuing from his left side. In a few seconds a human hand appears followed by a head and body, until at last the complete figure of a woman clad in light draperies apparently in a trance is visible. The woman walks across the stage to the footlights, opens her eyes in apparent wonder, exclaims, "Where am I?" The illusion has produced a profound sensation in London, and many were the theories which have been put forward. The true solution is however found in the so-called "black art."

In this illusion the entire stage from the first groove to the rear is hung with black velvet, the floor covered with black felt, and the top also, thus forming a room lined with black. The woman is garbed entirely in black and is provided with a black mask. The garments are made in sections adapted to be pulled away piecemeal until she is completely exposed in light raiment. Black cords manipulated by attendants behind the black back cloth pull away the black covering in detail or all at once. The number and style of tricks performed in the mysterious black chamber are almost unlimited. This is one of the most expensive of stage illusions, costing several hundred dollars to properly stage it with the best drapery and accessories, and unless such are used the proper illusory effect is lost. In magic as well as in other business, cheap apparatus is dear at any price.

A Startling Apparition.—The Figure Begins to Appear.

The Figure Emerging from Chaos.

The Apparition Completely Unveiled.

"BLACK ART" REDIVIVUS.

The Limits of Life.

BY DR. VICTOR GRAFF.

In general, life is closely dependent upon external conditions. Plants, for example, retain their vitality only within a narrow interval of temperature. But the limits of life recede as we descend in the scale of creation, adaptability being inversely proportional to evolutionary development.

Algæ are found growing in the hot springs of the Yellowstone, at a temperature of 176 deg. F., at which albumen coagulates. A bath in boiling water actually increases the germinating power of the spores of *Bacterium subtilis*.

Most of the organisms that are not killed by drying endure very high temperatures when dry. Yeast and the seeds of many plants germinate after exposure to dry heat of the temperature of boiling water.

Many organisms resist extremely low temperatures still better. Parts of many higher plants can be frozen without suffering the slightest diminution of the power of growth. According to Charpentier, Alpine clover (*Trilphium alpinum*), mountain areus (*Geum montanum*) and other Alpine plants live and grow after being covered by ice for four years. In experiments with liquid air Pictet exposed diatoms for a long time to a temperature of —390 deg. F., and Macfadyen cooled bacteria to —480 deg. F. without killing them. It is not yet known whether this astonishing resistance to cold is due to an entire arrest of the vital process or merely to its reduction to a minimum. It is certain that frozen fishes and frogs and completely desiccated rotifera and worms can be restored to normal life by heat and moisture, respectively, unless the abnormal condition has continued for a very long time. Beijerinck has discovered that chlorophyll-bearing parts of plants retain the power of assimilating carbonic acid when exposed to light even after they have been pulverized, and Molisch has obtained the same result with spinach leaves that had been dried, pulverized and mixed with water.

Buchner's discovery of cell-free fermentation and the isolation of zymase, the chemical compound to which fermentation is due, have thrown a new light upon the vital process in plants. Many processes which were formerly explained by the vital activity of living plasma are now regarded as purely chemical transformations due to enzymes, the production of which substances by living organisms constitutes the only connection between life and the processes in question.

This theory has recently been extended to the assimilation of carbonic acid, for Friedel and Regnard claim to have effected "photosynthesis" (assimilation of carbonic acid under the influence of light) with lifeless vegetable extracts, outside of the vegetable cell and in the absence of living protoplasm. Friedel's experiments have not yet been confirmed.

Molisch has also asserted that life is not necessary for carbonic acid assimilation, basing his assertion on the ability of desiccated spinach leaves, which had certainly lost the power of growth, to absorb carbonic acid and evolve oxygen. But to the writer it does not appear legitimate to assume that this is a case of assimilation by a dead organ, as we can not assert that an organism is dead merely because it is incapable of continuing a vital existence. Wiesner has pointed out that leaves in perfect health may be caused to fall by rain and frost following a drought. These leaves cannot grow, but they cannot properly be called dead.

I have proved by an extensive series of experiments that the respiration of lowly organisms like yeast and also that of the leaves of higher plants is a very complex process which involves several distinct stages and various factors which can replace each other to some extent and exhibit different degrees of sensitiveness to external influences. Dried yeast was heated to various temperatures and then added to solutions of sugar. Now yeast not only causes sugar to ferment but it completely oxidizes a portion of it. Carbonic acid is evolved in both processes, but fermentation also produces alcohol in definite proportion to the carbonic acid of fermentation. The excess of gas above this proportion must be ascribed to oxidation, or respiration. In fermentation, furthermore, sugar is simply resolved into alcohol and carbonic acid, while in oxidation a measurable quantity of oxygen is absorbed. In the cultures of heated yeast fermentation and oxidation took place simultaneously and in the same proportion for all temperatures of preliminary heating up to 120 deg. F. At this point there was a transient increase in oxidation, but with increasing temperature the oxidation decreased very gradually up to 230 deg. F., while the activity of fermentation remained constant. Heating, furthermore, diminishes the general vital activity, for, while yeast at normal temperature consumes by fermentation and oxidation all the sugar offered to it, after it has been heated to 230 deg. F. it is able to consume only 29 per cent of the sugar. Up to this point the ratio between fermentation and oxidation remains nearly constant, about 10 per cent of the *consumed* sugar being oxidized. Above 230 deg. F. the proportion of the *consumed* sugar that is oxidized rises very quickly to 67 per cent, because of the rapid decrease in fermenting power, which is destroyed entirely by heating to 266 deg. F.

There can be no "life" after exposure to such a temperature. The oxidation, to which I have given the name "dead oxidation," is caused by lifeless organic products or oxidases. But even the activity of these oxidases is diminished by heating. Heating the yeast to 340 deg. F. greatly diminished the evolution of carbonic acid, and the amount of oxidation that remained was proved to be due to inorganic substances, the activity of which was finally destroyed by heating the yeast to 480 deg. F.

These experiments prove that the production of carbonic acid is due to three factors—living protoplasm, lifeless organic enzymes, and inorganic "catalyzers"—which differ in their ability to withstand higher temperatures. At a comparatively low temperature the activity of the protoplasm is destroyed and the rapidity of oxidation falls. At a higher temperature there is a second fall caused by the failure of the enzymes, and at a still higher temperature oxidation by inorganic substances also ceases. The same law applies to higher plants. Similar results have been obtained by Palladin, in St. Petersburg.

It seems fair to assume that under ordinary conditions all these factors work together but that the lifeless factors become recognizable only when life is arrested or reduced to a minimum. Probably the living cell can employ all or only part of its vital energy, according to its need. These considerations suggest a plausible explanation of the tenacity of life under unfavorable conditions within certain limits.—Translated for the Scientific American from Umschau.

R. I. Phelps contributes an article to the Mining and Scientific Press of San Francisco on the furnace plant erected at Héroult, Shasta County, Cal., to treat the magnetic ores found on the divide between the Pitt and McCloud rivers. The current available is three-phase 60-cycle alternating current, which has not hitherto been used in electric smelting. Three carbon electrodes are used, each 18 x 18 x 72 inches. The water-cooled stepdown transformers deliver to the electrodes 30,000 amperes at 50 volts 60 cycles from the 22,000-volt potential of the power transmission line. The first heat was started on July 4, but after a few hours' work trouble developed, and the heat had to be stopped. After several hitches smelting has now been resumed, and the first heat tapped.

STRIKING A LIGHT.

BY PERCY COLLINS.

Looking round upon the civilized races of mankind to-day, one's imagination is sorely taxed to picture a time when the ready means of striking a light was not available. Yet it is certain that such a time must have been—far back in the dim ages, when man roamed the wilds and dwelt in holes and caves of the earth, scarcely more advanced in his domestic arrangements than the beasts of the field. In what manner the value of fire as a servant first dawned upon the mind of man must ever remain mysterious. But at all times there must have been fires and great conflagrations kindled by natural means and entirely without the aid of man. Thus, the effect of the lightning stroke, of friction caused by falling rocks or the chafing of limbs and stems in the dense forests, or the volcanic overflow of the smoldering furnaces within the globe, would from time to time display the properties of fire before the wondering eyes of primitive mankind.

Probably man first feared fire, then began to worship it as a god terrible and omnipotent to destroy. Then, his fear departing from him, he began to employ fire to benefit himself and his tribe, using it for cooking and warmth. Notice that he did not at first *make* fire. He took it from Nature's hand, so to speak, just as he gathered fruit from the forest boughs. There is direct evidence of this in the traditional history of many races. For example, the T'lingit family of Indians in southeastern Alaska say that the raven gave them fire, and have an elaborate folklore descriptive of the bird and its flight through inky darkness bearing the divine spark in a box. The fire was religiously preserved and fed, and members of the tribe took of it for their domestic hearths. These and similar fables of the preservation of fire in a box, and its being borne from tribe to tribe, or family to family, are reminiscent of the unquestionable fact that man knew and employed fire long before he had discovered the means of making it for himself.

Probably the first essays of man as a fire-maker were confined to the friction of sticks. There are just three ways in which one piece of wood may be rubbed upon another, namely, by moving with the grain, or "plowing"; by moving across the grain, or "sawing"; and by twirling a pointed stick within a wooden socket, or "drilling." All these methods have been used by early man. Neither the first nor the second method, however, was brought to a high state of perfection—or, to be more precise, they both reached perfection in rudimentary form. The fire plow, which was widely used among the Indo-Pacific races, and sporadically in America, consists of two parts: first, a stout piece of thoroughly dried wood perhaps 3 feet long and 2 inches in diameter, which forms the hearth or stationary part; second, a smaller stick of the same kind of wood, about a foot long, cut wedge-shaped at its lower end, the edge forming a very obtuse angle. This constitutes the working part, or plow. It was rubbed violently backward and forward on the stationary piece, cutting a groove running with the grain for a distance of some four inches. Minute shavings were thus detached, and, in the hands of a skillful manipulator, these were soon heated above the point of ignition.

Fire-making by sawing was a Malay device, and has never, perhaps, been successfully employed save in countries where the bamboo flourishes, the reason being that bamboo is the only really suitable wood. Two pieces are taken, one with a sharp edge, the other with a notch cut in it nearly, but not quite, severing the substance. After sawing for a time, the floor of the notch is completely pierced, and the heated particles fall below and ignite.

But the most important method of primitive fire-making is that of drilling. In its most simple form a stick of dry wood is twirled vertically between the hands upon a very dry and partially decayed lower platform. It is extremely difficult to obtain fire in this way, as modern experimenters may prove for themselves. Yet there is a certain knack about the operation, and this once being mastered, smoldering wood dust may be created with comparatively little labor.

It is clear, however, that the fire drill could be made more effective and rapid in action in several ways. One such way calls for the co-operation of two individuals, one of whom supports the vertical spindle by means of a socketed rod, while the other wraps a cord about the spindle and pulls it backward and forward as rapidly as possible. No doubt a strip of hide took the place of a cord in primitive times, while if the reader will examine a collection of Eskimo men's tools in any museum, he will find that many of them have a cavity somewhere along the middle of the handle, enabling them to be employed as a socketed rod in this kind of fire-making.

A further complication of the fire drill was the application of the bowstring—similar to the drilling appliance used by the jeweler. The socketed rest for

"Plowing."

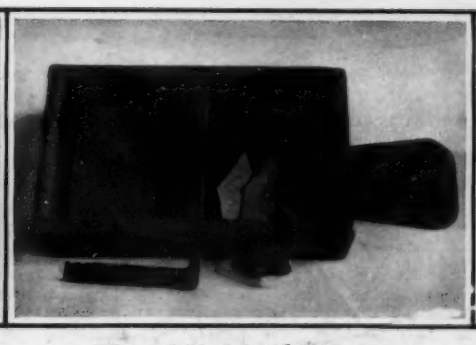
"Drilling."

"Sawing."

Drilling With Bowstring.

String-operated "Fire Drill."

Flint and Pyrites With Moss for Tinder.



Flint and Steel Set With Paper Matches.

Using the Flint and Steel Set.

Metal Tinder Box With Steel and Flint.

"Chamak" Steel and Flint Set of the Himalayan.

Pistol-like Tinder Box and Bundle of Sulphur-tipped Matches.

Method of Striking a Light With Flint and Steel.

"Oxymuriate" Match.

First Lucifer Match.

"Promethean" Match.

Modern Safety Match.

METHODS OF STRIKING A LIGHT.

the vertical shaft was then held by one hand, while the thong was alternately pulled and slackened with the other. Thus a saving of labor was attained. One worker was able to command results equal to those produced by two working without the bowstring. Still more elaborate and effective fire drills were evolved by savages. Among the Iroquois, for example, the pump-drill is reported. Its parts are the vertical shaft, the fly-wheel or spindle-whorl, the hand-piece by the up and down motion of which the drill is worked, and the string. The hand-piece is a stick held in the hand and attached at its extremities to the cord, which passes over a notch at the top of the spindle. The hand-piece is either perforated, the shaft passing through it loosely, or (in the ruder forms) it simply rests against the spindle. To set the apparatus in motion, the string is twisted once or twice about the shaft, and kept in motion by moving the hand up and down.

The forerunners of the comparatively modern flint and steel as a means of striking a light were flint and pyrites, or two pieces of pyrites. These were struck together, and the sparks thus generated were caught among a little dry moss. The Eskimos from Smith Sound to Behring Strait use this method. A very complete strike-a-light set, including flint, pyrites, tinder in dainty little bags, and a leathern pad to guard the fingers, comes from Cape Bathurst. Evans points also to Fuegia and the European archæological sites for the antiquity of this method.

Modern forms of the flint and steel are well known to most people from examples preserved in museums. Photographs of several of the more interesting varieties are here reproduced. There is the very old type of wooden box, perhaps the earliest strike-a-light set made by civilized mankind. With this are certain small angular pieces of stout paper, the tips of which are dipped in sulphur. These are the most primitive kind of match known. They were used for generating a flame, by application to the smoldering tinder. Genuine specimens of these matches are now extremely rare, though "faked" ones are often offered for sale by dishonest dealers in curios.

Another, and more compact, type of tinder box is of metal. In the bottom is seen the old dry rag, used as tinder, and upon this the flint and steel reposed when the box was not in use. Still more interesting is the ingenious strike-a-light made in the form of a pistol. The flint is worked by the trigger, and strikes upon an upright plate of steel, throwing the sparks through an opening upon the tinder contained in a narrow box which takes the place of what would be the barrel in the case of a pistol. This contrivance is a relic of the old stage-coach days. By means of it a light could be struck in a high wind. The matches which were then used were strips of thin pine wood, the ends being dipped in sulphur. One other tinder box may be mentioned, namely, the "chamak"—still in use among the Himalayan tribes. It is a little leathern pouch containing flint and tinder, while the steel is a strip of metal riveted along one side of the pouch. It is of small size, suitable to be carried about the person.

In conclusion, we may dwell briefly upon the developments of the match proper, as perfected by civilized man. Phosphorus was discovered by Brandt in the seventeenth century, and was used as a means of obtaining fire shortly afterward. But its costliness, together with the danger attending its use, militated against its popularity. But in the year 1805, the Parisian Chancel introduced the so-called oxymuriate match. It was a slip of wood tipped with a mixture of chlorate of potash, sugar, and gum. To ignite it, the match was thrust into a bottle containing a piece of asbestos saturated with sulphuric acid: an awkward arrangement, especially in the dark.

Then came the "Promethean" matches, whose career was short-lived. They were a kind of paper cigarette, dipped in a mixture of sugar and chlorate of potash. Rolled within the paper was a tiny glass bulb filled with sulphuric acid. To strike these matches, the tip was compressed between the teeth or pliers. By this means the bulb was broken, the acid liberated, and subsequent chemical action caused ignition of the paper.

The first really practical lucifer match, however, was invented by John Walker, of Stockton-on-Tees, in 1827, and by him named after Sir William Congreve, of rocket fame. It consisted of a splint of wood first tipped with sulphur, and then with a chlorate mixture. These matches were drawn rapidly through a piece of folded sandpaper to ignite them. It is curious to note that a tin box containing seven dozen of them, together with the necessary bit of sandpaper, cost one shilling.

Finally, after endless experimenting, inspired by handsome prizes offered by America, England, and other enlightened countries, the non-phosphorus safety match was brought into being, putting the top stone, as it were, upon man's monumental struggle with the problem of striking a light.

It is a curious commentary on the old world's slowness of inventive genius that the first practical match should have been made less than a century ago.

Tests of Balloon Envelope Fabrics Under Severe Weather Conditions.

Some interesting experiments were carried out recently by Carl E. Myers at his well-known balloon farm in Frankfort, N. Y., nine miles east of Utica. These experiments had in view the better retention of hydrogen gas in balloon fabrics, the handling and decanting of hydrogen from one vessel to another speedily without loss, and the operation of captive balloons and airships for long periods, exposed to all variations of weather, good and bad. The extreme hot, cold, rainy days, with wind and thunder storms, of the past few weeks, which wrecked farms and buildings throughout this section of the country, have been utilized to test the balloons exposed out doors almost constantly to whatever weather occurred. The extension of the use of captive balloons in the army, to which Mr. Myers has contributed over a hundred, and the late attempts of the French and German governments to make longer flights than two hours with airships, have demonstrated the necessity of approved methods for retaining hydrogen gas in balloon fabrics.

During the week of July 4 Mr. Myers operated his captive balloon, carrying hundreds of passengers, and concluded with a cut-loose voyage by himself and assistant, landing an hour later, and anchoring till morning, when the same balloon arose again, carrying Mr. and Mrs. Myers, who made a six hours' journey. This continuous use of a hydrogen gas balloon during five days, both as captive and free, has never been equaled. Since July 6 this balloon and another like it have been almost continually inflated out doors at the balloon farm, exposed to all kinds of weather.

On Monday morning, July 29, a motor airship was substituted, with which the same evening Mr. Coughlin, of Dayton, Ohio, made several flights to learn its control, followed by three free flights for practice. Tuesday evening the same airship made several flights over the balloon farm grounds with Mr. Coughlin, for further practice. Wednesday the hydrogen from this airship was decanted into another of exactly the same pattern, and Mr. Coughlin, who had bought the former airship, left with it for Columbus, O., where he expects to use it for exhibition. Mr. Myers' latest airship remains anchored out doors at the balloon farm, exposed without harm to the rain and thunder storms prevailing since, which prove the worth of this airship in all kinds of weather.

On August 2 a terrific storm of wind, rain, and hail passed over the balloon farm, but did no damage to the new airship. Not a puncture was made by the thousands of hail stones of all sizes dancing on and rebounding from the elastic envelope, which retained its hydrogen without any loss. Half an hour later the warming sunshine had re-expanded the contents, which had been shrunken by the chilling storm, and the gas bag had now to be allowed more space within its netting to avoid possible rupture. This test is regarded as the most marvelous in this line of experience.

Green and Blue Gold.

When precipitating by means of cathode projection thin transparent films of gold on a glass plate, two kinds of deposits can be obtained according to the method used. One kind of film is found to be green in transmitted light and yellow in reflected light and is optically identical to hammered gold foil. The other film is deep blue in transmitted light while showing, like the former, a metallic brilliancy in reflected light, but of a paler yellow.

Prof. L. Houllevigue, of Marseilles, by his recent researches on these two varieties of gold, an account of which he presented to the French Physical Society, has found that the latter variety, while being stable at ordinary temperatures, will be transformed into green gold on being heated beyond 130 deg. C. (266 deg. F.), and at the same time will lose 7 to 8 per cent of its weight, while its electrical conductivity is increased considerably.

As the green and the blue gold cannot be chemically identical, Houllevigue ascertained the chemical composition of the latter variety, which was found to be identical with gold hydride. In fact, when using a film of blue gold as anode in a voltameter containing acidulated water, the oxygen evolved at the surface is found to reduce the gold film to the state of metallic gold, the film becoming green. If, on the other hand, some blue gold be inserted in a Plücker tube which, after being exhausted and carefully dried, is sealed, this tube, when excited by electric discharges, will not give the spectrum of hydrogen; the latter will, however, appear if the tube has been raised to the temperature of conversion at which the blue gold is decomposed into metallic gold and hydrogen.

The character of a deposit obtained by cathode projection mainly depends on the temperature of the room in which the experiment is made, blue gold being obtained in the case of a low temperature and green gold in that of high temperatures. According to these phenomena, the cathode would project normally gold hydride, which is either decomposed or remains unaltered. This accounts for the fact that blue gold is obtained by operating slowly, and green gold by hastening the process, and that deposits of variable thickness are generally blue in the thinner and green in the thicker portions. The same fact affords an explanation of the aging of cathodes, a gold cathode which when new gives blue gold, yielding exclusively green gold after some prolonged usage. In fact, if one-half of this cathode be lined with galvanoplastic gold, blue gold is found to be precipitated by cathode projection on the newly gilded portion and green gold on the other half of the cathode. The more hydrogen a cathode contains, the less hard will the tube be and the lower the temperature in the parts surrounding the cathode.

Geologic Work in National Forests.

The United States Geological Survey, in connection with its other work in the West, has undertaken to examine geologic conditions in the national forests. It has been the policy of the government to encourage mining in the areas included in the national forests, but many fraudulent entries have been found, which cover non-mineral lands or deposits that by no possibility could be developed into paying mines, and it is clearly in the interest of legitimate mining enterprises to prevent "wild-cat" mining companies from obtaining titles to the lands covered by such claims.

The work of the Survey will be of practical value both to the Forest Service and to the miners, for the reports of the geologists will enable the Forester to make recommendations to the Commissioner of the General Land Office on the character of mineral locations. The policy of the Survey will be to require its geologists to assist in every way the claimant who is acting in good faith and to help the officers of the Forest Service in their task of protecting the mining industry and all other interests which benefit by the proper administration of the national forests.

A New Extinct Elephant from Africa.

In the final report of a recent geological survey of Natal and Zululand, Dr. W. B. Scott, the well-known palæontologist of Princeton, New Jersey, gives a description of the two last lower molars of an extinct elephant obtained from a deposit of late Tertiary age in Zululand. For the elephant the author proposes the name of *Elephas zulu*. Its teeth have their constituent plates more numerous and thinner than are those of the existing African species, and they are described by Dr. Scott as being to a great extent intermediate in this respect between the latter and those of the extinct European and Asiatic *Elephas antiquus*. To Mr. R. Lydekker, who writes on the subject in Knowledge and Scientific News, they seem to be much nearer the molars of the species last named. It is suggested that *E. zulu* may have been the ancestor of the living *E. africanus*, in which case it would almost be imperative to regard the molars of the latter as being of a degenerate type. This question requires very careful consideration; but, apart from this, the discovery is one of great interest.

The Current Supplement.

The opening article of the current Supplement, No. 1652, deals with the giant floating dock which was recently sent from England to Trinidad. Mr. J. H. Morrison begins an interesting series of historical articles on the development of armored war vessels. Col. C. W. Larned's excellent paper on the history of map-making and topography is completed. Curious examples of old maps are published with the text. The Paris correspondent of the Scientific American writes on European automobile fire apparatus. A very complete account of Dr. Cushman's theory of the electrolytic corrosion of iron is published, and will be continued in the next number. Prof. James Swinburne contributes an excellent paper on incandescent illuminants. The fuel-testing plant of the United States Geological Survey at the Jamestown Exposition is described and illustrated. George M. Little writes on new developments in arc lamps and high-efficiency electrodes, and gives some interesting comparisons between metallic and carbon arcs. An historical review of chemical conceptions is given by Prof. Charles Baskerville.

The cultivation of bamboos on an extended scale is contemplated by the Japanese residents of Victoria, B. C. Experimental growths have proved very successful, and during the coming winter many roots will be imported from Japan. The cultivators hope to develop a big trade in bamboo furniture; and also to introduce the use of bamboos as water pipes, a purpose for which they have long been in use in the Orient. Bamboo cultivation is a profitable industry in Japan, where the returns from an acre yield from $20 to $90.

THE RACES FOR THE ASTOR AND KING'S CUP.

All things considered, the annual cruise of the New York Yacht Club for the year 1907 was the most successful event of the kind in the history of this famous institution. Incidentally, it served to show that in the United States the noble sport of yachting was never more flourishing than at the present time; for when the fleet started on the first day's run, from Glen Cove to New London, considerably over one hundred yachts were flying the pennant of the New York Yacht Club; the greater part of whom followed the fortunes of the cruise until the fleet was finally disbanded.

The event opened with a race off Glen Cove, followed the next day by a beat to windward through the waters of Long Island Sound to New London. The next day there was a reach from New London to Newport; and following that, on the third day, was another reach, to Vineyard Haven. Returning, there was a stretch of windward work to Newport, where, on Friday and Saturday of last week, two excellent races were sailed for the Astor and the King's cups, the former race being somewhat marred by the light and fluky character of the wind, and the King's cup race being favored with an excellent sailing breeze of moderate force. During the whole cruise there were races for nineteen special cups, a dozen of which were given by the flag officers of the fleet; two by John Jacob Astor, and one by King Edward, while four were challenge trophies. Over and above these, were forty-five class races, for many of which second prizes were offered.

The principal interest centered in the 90-foot schooner class and the new 57-foot sloop class. The former was represented by three famous schooners, the "Elmina," designed by Carey Smith; "The Queen," a new Herreshoff boat of last year, and the famous "Ingomar," also from the Herreshoff boards, which a few years ago made a clean sweep in a season's racing against the crack schooners of England and Germany. In this class, also, was the little schooner "Venona." The 57-foot class was represented by four exceedingly handsome sloops, all designed and built by Herreshoff this year. Three of these, the "Aurora," "Winsome," and "Istalina," were built up to the limit of the 57-foot rating and were practically identical boats. The fourth, and most successful from the prize-winning point of view, the "Avenger," was built with a view to securing the full advantage of the time limit, her rating being about 48, or just sufficient to bring her into the class. Her large time allowance, coupled with the fact that she was built with hollow spars, and had all the advantages of purely racing construction, caused the "Avenger" to win out against the three larger sloops on time allowance, generally with a considerable margin to spare.

The Astor cup for schooners was won in a light and rather fluky breeze by Rear Commodore F. F. Brewster's schooner "Elmina" after a close race against the "Queen" and "Ingomar." She beat the "Queen" by 1 minute and 16 seconds corrected time, and the "Ingomar" by 9 minutes and 59 seconds. The course was laid with the first leg to a mark off West Island, a distance of 6½ miles; the second leg to a mark off Block Island, 18 miles; and a home leg of 13½ miles, making a total course of 38 miles. Among the schooners, "Queen" led at the first mark, having taken 54 minutes, 58 seconds over the leg. "Ingomar" came next in 55 minutes, 54 seconds, and "Elmina" in 56 minutes, 19 seconds. "Queen" was still leader at the Block Island mark in 2 hours, 22 minutes, 57 seconds, followed by "Ingomar" in 2 hours, 26 minutes, 2 seconds, and "Elmina" in 2 hours, 30 minutes, 6 seconds. Here the wind softened considerably, and "Elmina" drew to the front, her time for the third leg being 1 hour, 58 minutes, 7 seconds, "Queen" being second in 2 hours, 10 minutes, and 16 seconds, followed by "Ingomar," 2 hours, 13 minutes, 44 seconds. On corrected time the "Elmina" beat the "Queen" by 1 minute, 16 seconds, "Ingomar" by 9 minutes, 59 seconds, and "Winona" by 20 minutes, 17 seconds.

Among the sloops, of which fourteen started, the "Avenger" was winner on corrected time, in 5 hours, 17 minutes, and 40 seconds. In her own 48 to 57-foot class the "Winsome" came nearest to the "Avenger," her corrected time being 5 hours, 24 minutes, 38 seconds. That the "Avenger" should have beaten the "Effort," as she did, by 13 minutes and 3 seconds marks her as a phenomenally fast boat, and proves that Herreshoff's hand has lost none of its cunning.

Although the race for the King's cup was inaugurated only last year, it has come to be as famous an event in its way as the race for the Astor cup. There were nine entries for the race, and seven crossed the starting line, the absentees being the "Weetamoe" and the "Effort." The race was sailed over one of the King's cup courses laid out last summer, the first leg being 12 miles, the second 11¼ miles, and the last leg 12 miles in length, making a total course of 35¼ miles. There was a fine breeze, and so much promise of more to come that the sailors had on oilskins in preparation for the thresh to windward. The "Queen" sailed the first leg in 1 hour, 46 minutes, 12 seconds, the "Ingomar" in 1 hour, 45 minutes, 33 seconds, the 57-foot "Istalina" took 1 hour, 59 minutes, 32 seconds, and the "Avenger" 2 hours, 7 minutes, 42 seconds. The second leg was a reach of 11¼ miles, and the "Queen" drew slowly away from "Ingomar," her time for this leg being 1 hour, 5 minutes, 53 seconds, and that of "Ingomar" 1 hour, 7 minutes, 45 seconds. The little "Avenger" actually made better time over this leg than the larger sloops. The race was finally won by "Queen" in 3 hours, 30 seconds, corrected time, the "Ingomar" being second in 3 hours, 34 minutes, the "Avenger" third in 3 hours, 43 minutes, 24 seconds, followed closely by the "Istalina," "Aurora," and "Winsome" of the same class, the last being the "Neola," whose corrected time was 3 hours, 51 minutes, 27 seconds. The coveted trophy, therefore, for this year goes to the "Queen," which last year finished far in advance of the fleet, only to lose the cup on corrected time to the sloop "Effort."

Automobiling and Health.

Interesting researches on the influence of automobiling on health have been recently made by A. Mouneyrat, and communicated to the French Academy of Sciences. After the favorable influences exerted by an automobile trip on the skin, the organs of respiration, blood circulation, and nervous system had been first ascertained by Dr. Legendre, the effects produced by the rapid air exchanges on such a trip, both on normal, anæmic, and neurotic persons, have now been investigated by Mouneyrat. He made many experiments during automobile tours lasting eight days, with an average speed of 25 miles an hour and a daily run of 60 to 125 miles, both in spring and in summer, when a striking increase in the number of red blood corpuscles was noted. In normal persons the number of blood corpuscles on the day of starting was found to be 5,200,000 per cubic millimeter, while as many as 6,700,000 were found after eight days. In an anæmic person 4,530,000 corpuscles were found on the day of starting and 5,300,000 after eight days, while in another anæmic person the number increased from 4,300,000 to 5,600,000. In the first person the percentage of red corpuscles would thus increase by about 29 per cent, in the second by 18 per cent, and in the third person by 30 per cent.

An automobile trip results therefore in a considerable increase of the percentage of red blood both in normal and anæmic persons. On the other hand, an excessive appetite also occurs. It is interesting to note that an automobile trip will produce the same effect as a stay in the mountains, the increase in the number of red blood corpuscles observed at a height of 1,200 to 1,800 meters being about equivalent. The trip induces deep sleep both in normal and neurotic persons; the latter, who normally sleep but little, rapidly becoming normal.

Hand Loom Weaving in India.

Hand loom weaving is making considerable progress in the Madras Presidency in India. Several factories have been established, the most important one containing forty to fifty looms, at Salem, under the direction of Mr. A. Chatterton, director of industrial and technical inquiries in the Madras Presidency. Here various looms have been installed to test their relative merits. So far an English hand loom with an automatic take-up motion has proved the best. These are manufactured in the School of Arts, Madras, where a loom with 54-inch reed space costs, exclusive of reeds and healds, 85 rupees ($42). The best reeds and healds come from England. The reeds are made of brass and the healds are fitted with steel eyes. In this loom cloths can be manufactured from yarn of coarse counts or a degree of fineness beyond that for which there is any considerable demand. It is understood that in the hands of a skilled weaver it can be used for any class of work that can be done on the native hand loom.

For the present, attention in the Madras Presidency is mainly directed to improvements in the methods of preparing warps and sizing them. Experiments in hand-sizing have proved a failure, and it seems almost certain that the present methods of sizing will have to be retained in any process of warping which may be devised. Already the use of warping mills is very common throughout the Madras Presidency, and in Salem, for instance, it is usual for weavers to get their yarn warped at a separate establishment where nothing else is done.

Roofing Paper Paint (according to R. Roedelius.)—Distilled coal tar 25 parts, distilled wood tar 18 parts, silicic acid 15 parts, magnesia 10 parts, linseed oil 6 parts, authracene oil 6 parts, iron oxide 8 parts, oxide of lead 8 parts, silicate of soda 4 parts. At a temperature of about 212 deg. F., thoroughly mixed together into a syrup-like mass. This, applied thin, changes within 12 hours into a plastic cement, of gutta-percha-like quality, that is very weather resistant.

SOME NOTABLE GERMAN BRIDGES.

BY F. C. KUNTE, C.E.

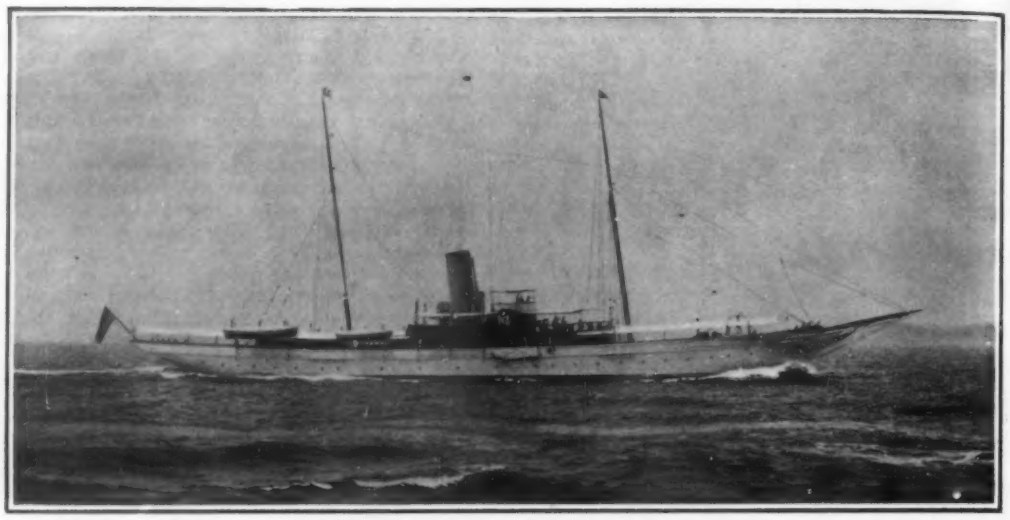
The accompanying illustrations of German bridges show what particular attention is paid to the esthetic appearance of bridges in Germany. Artistic taste and consequently the growth of art are the result of the continuous impressions we receive from the beautiful surrounding us. Beautiful public buildings, monuments, fountains, parks are as much the cause as the effect of the appreciation of art. The construction of a bridge in or near a city should be a welcome opportunity for a beautiful structure. We do not need any medieval towers at the ends of our bridges, as they would be meaningless to us. American rivers have been and are means of communication, not natural barriers like the historic Rhine, but there is a wide field between a medieval tower and an anæmic-looking end portal with a 5/16-inch web plate, a few punched holes representing the figures of the year of completion, a few punched rosettes and perhaps a bronze plate stating that the bridge is able to carry "a live load of 80 pounds per square foot of floor and a concentrated moving load"—and all that connected to the end posts of an unsightly Pratt truss with a few rivets, usually not strong enough to take the wind shear. The one is the work of an architect advised by an engineer, the other the work of an engineer trying to be a decorator. The only salvation is co-operation of engineer and architect, since it is impossible for any one man to master both branches of the art of building.

Up to the nineteenth century bridge-building was considered a part of architecture. The distinction between architect and engineer originated soon after the French revolution, when during the reorganization of the Académie d'Architecture in Paris a breach occurred between the "Decorateurs" and "Constructeurs." With the specialization of their work and the extensive use of iron for bridges and other structures the breach widened until finally the necessary mathematical training of the engineer made of him a hopeless utilitarian. In his address as president of the Institution of Civil Engineers, the late Sir Benjamin Baker, referring to the Firth of Forth bridge, remarked that, if engineering structures built on the line of utility and economy do not appeal to the artist, he has to change his requirements of their beauty. Similar ideas were expressed by many others, and they have had a wholesome influence on engineers and architects in wiping out useless construction and senseless ornamentation—we smile today at the highly ornamented guns, flying machines, and other "tools" of the eighteenth century; but it certainly is more than doubtful that because a statically incorrect structure is not rational and therefore not beautiful, a statically correct one is necessarily beautiful. Much more justified would be the expression that the correct but ugly structure is only partly correct.

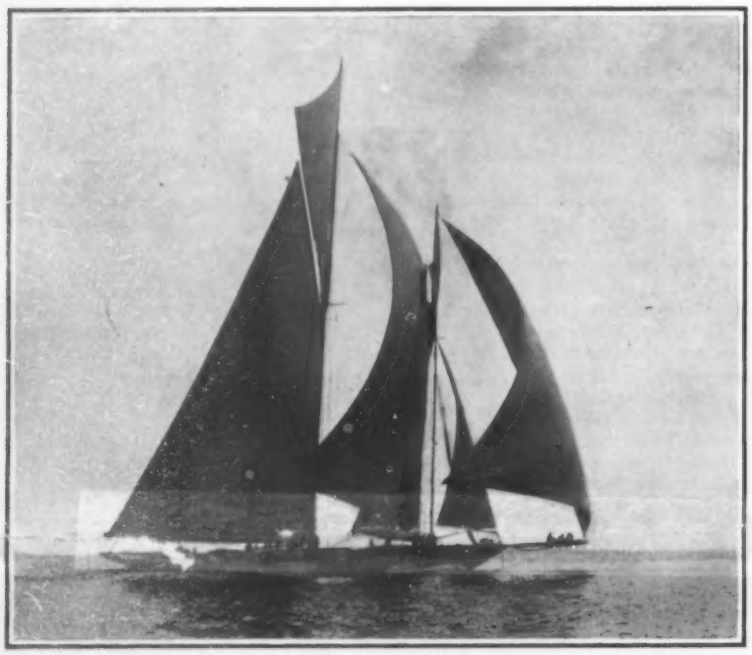
The first of our front-page illustrations shows the highway bridge across the southern branch of the River Elbe at Harburg, built 1897-1899 at a cost of $420,000. It consists of four arch spans of 331 feet each, weighing 2,270 tons, and six deck spans of 192 feet, weighing 600 tons. The roadway has a clear width of 23 feet, accommodating one trolley track. There are two 8-foot sidewalks, carried by brackets outside of the trusses. The truss system is a "two-hinged" braced arch with a tension member under the floor, tying the two end hinges together. The tension in the tie replaces the horizontal resistance of the abutments against overturning, forming with the arch one elastic truss system exerting only vertical pressures on the supports. Uniform changes in temperature do not cause any stresses because the tie will change its length with the other arch members, provided one hinge is placed on rollers. The greatest advantages of the vertical pressure on the supports, however, occur in the case of several consecutive arch spans; as without the tie, the intermediate piers and their foundations would have to be very thick to resist the horizontal thrust resulting.

In this bridge the so-called "secondary"—usually neglected—stresses, caused by the customary rigid connections of the floor beams to the trusses, were reduced in making the floor system "freely suspended," so that its vertical elastic deformations are entirely independent of those of the trusses. Each floor beam is fastened to the suspenders by means of a pin instead of being riveted, with the only exception of the center floor beam, which is rigidly connected to the suspenders. The horizontal ties of the trusses and the lower horizontal wind bracing form thus a fixed line to allow the floor system to expand or contract toward both ends. For the same reason no vertical, but only a horizontal upper wind bracing is used. The lower horizontal wind bracing consists of stiff diagonals riveted to the two ties, but having no connection whatever to the floor beams, the wind force coming from the live load moving across the bridge being transmitted to the leeward tie by means

"Avenger," Winner of Astor Cup for Sloops.

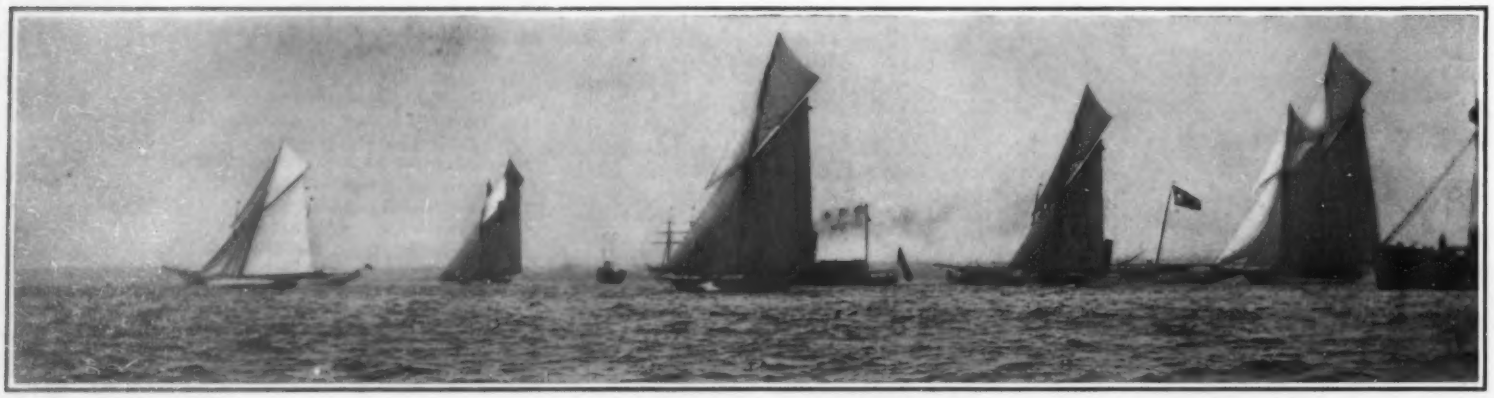


Commodore Cornelius Vanderbilt's Flagship "North Star."

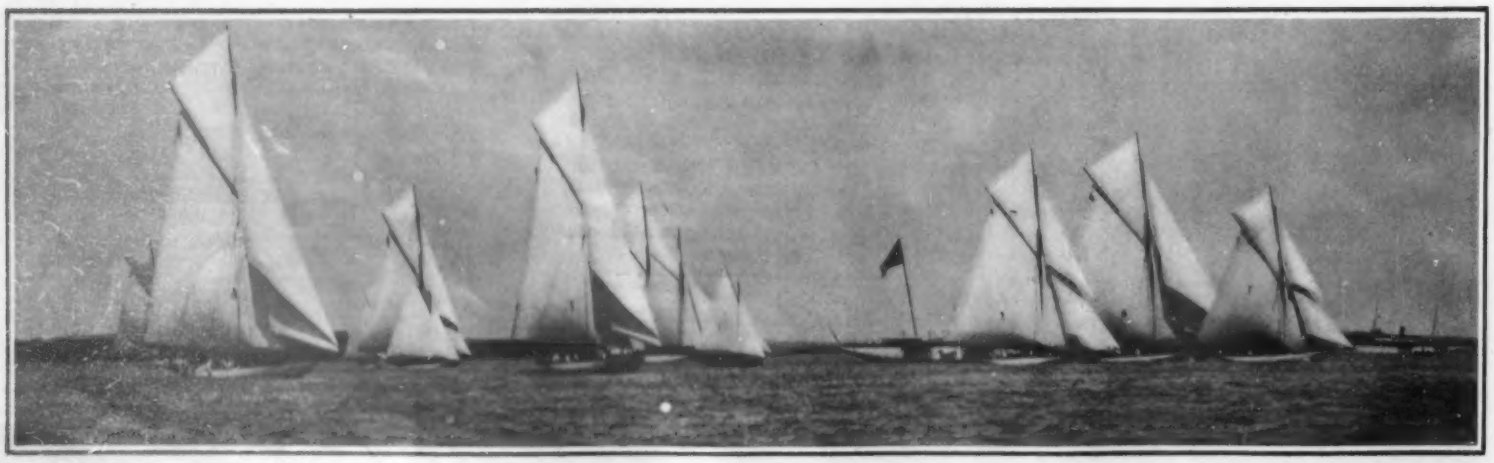


"Queen," Winner of the King's Cup.

"Elmina," Winner of the Astor Cup for Schooners.



Start of the Race Off Newport for the King's Cup.

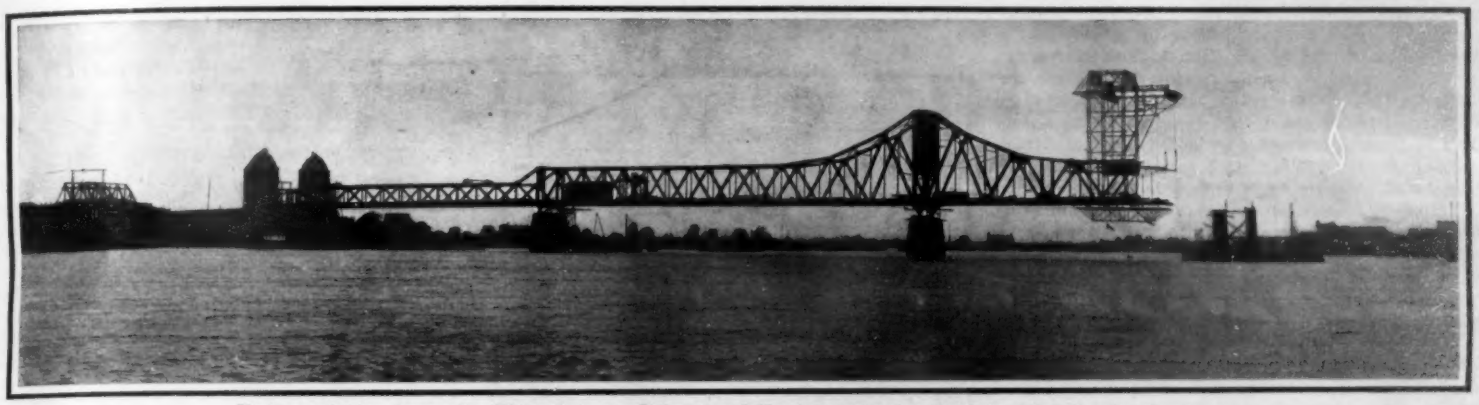


Start of the Sloops for the Astor Cup.

THE 1907 RACES FOR THE ASTOR AND KING'S CUPS.

of a loose vertical butt joint formed by small projections of the bottom chord of the floor beam.

This fact is very interesting, showing that European engineers are adopting articulated connections in their briges—at least in a transverse direction—at a time when American engineers are abandoning pins and eye-bars in lighter bridges in favor of riv-

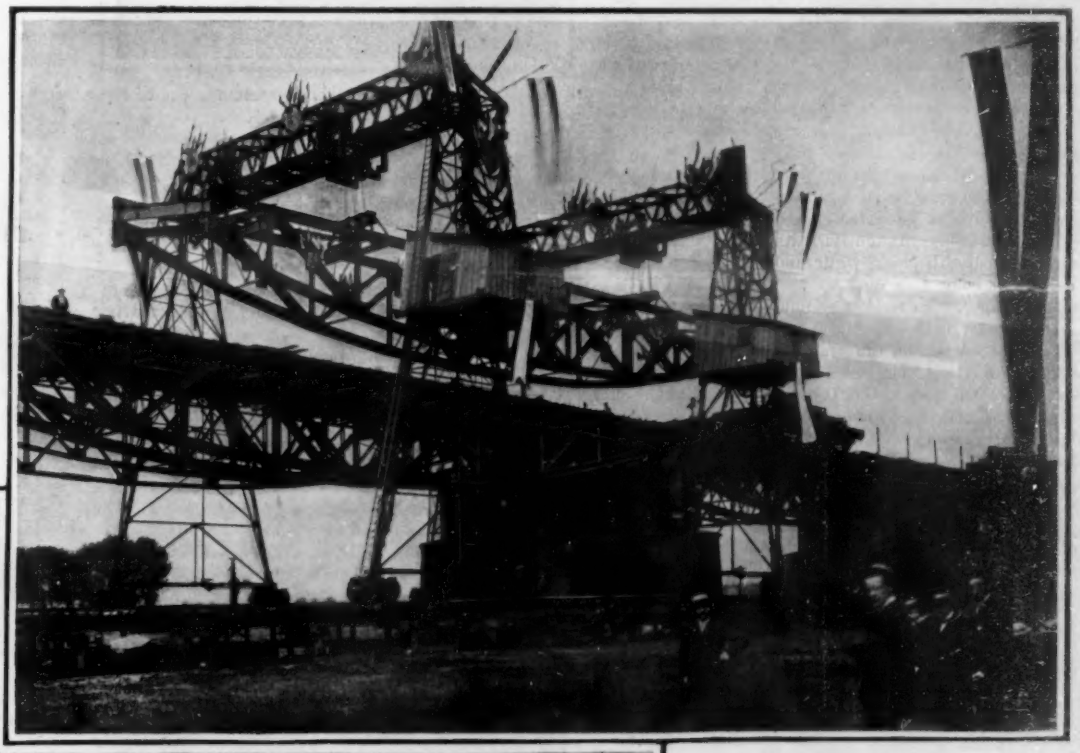


Highway Bridge Across the Rhine Between Ruhrort and Homberg, Showing Method of Erection by Overhang.

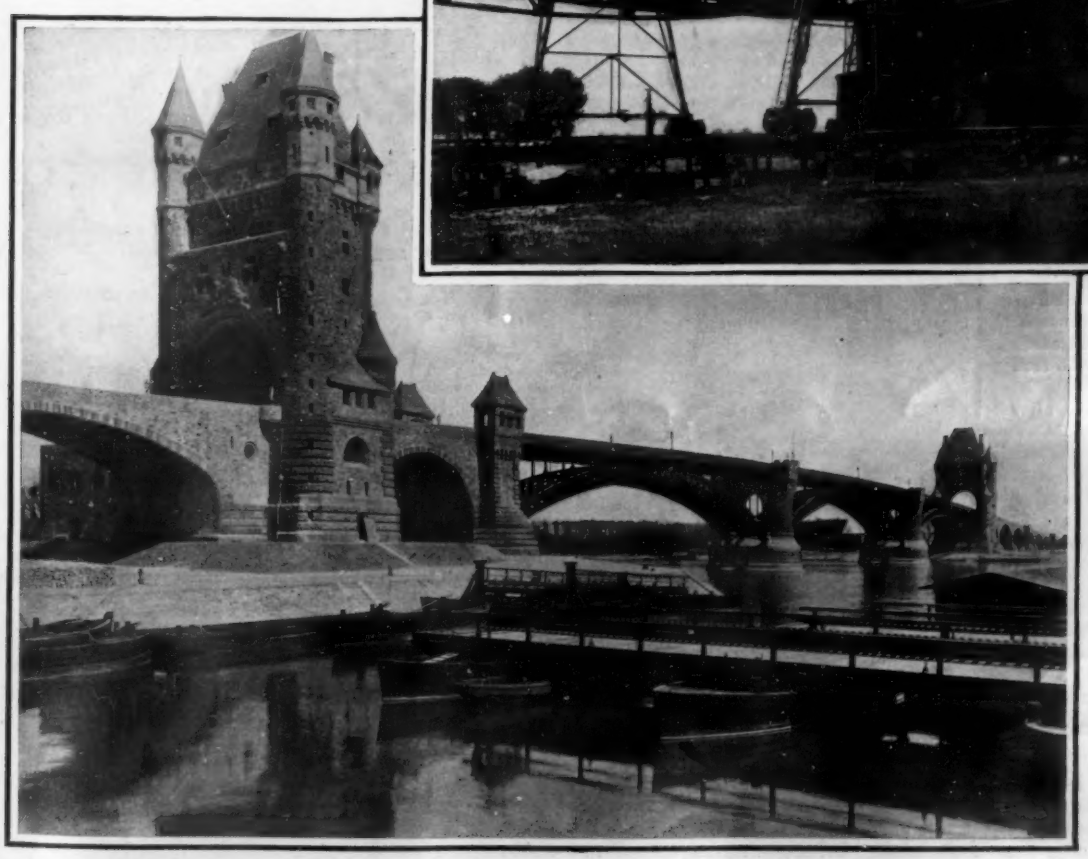
eted connections for the sake of greater rigidity under traffic. This construction will hardly be copied in this country. A bridge should be a stiff structure in space, able to resist unforeseen shocks, stresses, etc., and not be stiff in a longitudinal and transversal plane independently. Stiffness, that is, freedom from excessive deflection with vibration, is just as necessary to lengthen the life of a bridge as is its strength expressed in so-and-so-many thousand pounds of permissible working stress per square inch under a probable live load; but it does not generally receive the attention it deserves, because it cannot as easily be defined.

The lower front page illustration shows the railway bridge at Mainz which crosses two arms of the Rhine and an island, to accommodate two tracks and two sidewalks for the considerable length of 3,000 feet. It cost $1,300,000. The two river crossings consist of three and two arch spans respectively, the span lengths varying between 306 feet and 382 feet. The truss system is the same as in the bridge described above, that is, a braced arch with a tie connecting the end hinges. It is not clear why the river piers were not extended a little higher, as has been done, for instance, in the bridge across the Rhine at Düsseldorf (see SCIENTIFIC AMERICAN SUPPLEMENT, February 23, 1901), to prevent the stilt-like appearance of the steel structure at the piers. The viaduct across the island consists of six deck spans with parabolic trusses of 130 feet span each. In the accompanying illustration these trusses are shown being erected from a traveling gantry. The floor system is also here "freely suspended," which is even less commendable in this case, since the bridge carries railway traffic. The bridge being located at the gates of the old city of Mainz, whose history reaches back into ancient Roman times, special care was taken in the architecture of the abutments to express the strategic importance of this location in history, and it must be admitted with great success. The massive abutments are relieved below the floor by masonry arches while carrying above a superstructure of masonry composed of defiant medieval towers of great beauty.

Another view represents the highway bridge across the Rhine at Worms, built in 1897-1900. It consists of one center span of 346 feet and two side spans of 310 feet each, with a total steel weight of about 2,000 tons. There are masonry approaches on both sides, consisting of 12 concrete arches with 3 hinges and spans varying from 70 feet to 115 feet. The roadway is paved with wooden blocks on asphalt and has a clear width of 22 feet. There are two sidewalks 7 feet wide, each carried on brackets outside of the trusses. The arch trusses located entirely below the floor are 25 feet apart, have two end hinges and the shape of a crescent to indicate the concentrated reactions at the hinges. The rise of the center line is very small, being only about one-tenth of the span. To accentuate the boldness of the outline with a flat curvature in the center, giving also more clearance for the river traffic and at the same time keeping the hinges low to reduce the lever arm of the great horizontal thrust, the center line of the arch is an elliptical curve. The depth in center is about one-fiftieth of the span. Architecturally the bridge is a model. The arches being below the floor clearly show their static function, while the portals, treated as massive masonry towers, furnish the necessary horizontal stability, giving at the same time expression to the historic dignity of the place. The masonry is treated in a simple manner, to impress more with its massiveness than with small ornamental detail. If we were allowed to express a wish, it would be that the three river spans had been made a little longer and



Island Spans of the Railway Bridge at Mainz, Showing Erection of Trusses by a Traveling Gantry.



Highway Bridge Across the Rhine at Worms; a Fine Example of Correct Architectural Design.

SOME NOTABLE GERMAN BRIDGES.

the masonry arch adjoining the one tower on the river side left out, making the river crossing symmetrical, both towers accentuating the limits of the steel construction.

Another view shows the highway bridge across the Rhine between the cities of Ruhrort and Homberg during erection. The construction began in 1905 and will be finished this year at an expense of about $1,100,000. The width of the street is 53 feet between railings, and the distance between trusses 36 feet. The total length will be 2,000 feet, with a center span of 667 feet, which will make this the longest span in Germany, and, with only two exceptions, the longest in Europe; the larger spans being, in the Viaur viaduct in France, 722 feet, and in the Firth of Forth bridge in Scotland, 1,710 feet. A span of 667 feet is too long for an ordinary truss bridge, the longest so far built being 546 feet. An arch or suspension bridge would have been possible, but these were considered undesirable on account of the danger of settlements of the foundations caused by coal mines near the bridge site. The only system left was the cantilever, which exerts vertical reactions only, and this was adopted. The outlines of the trusses are very pleasing, which is indeed rare in cantilever bridges. It is interesting to note that in spite of the great weight, the trusses are riveted throughout, no eyebars or pin connections being used.

THE SHEEP-KILLING KEA.

BY GEORGE E. MASSINER, F.R.M.S., ASSISTANT IN BIOLOGY, CANTERBURY COLLEGE, NEW ZEALAND.

New Zealand has its full share of interesting animals, but with the exception of that strange out-of-date lizard-like animal, called by the Maoris the tuatara, the avifauna claims them all. The extinct moa, that giant of the bird world, is the only bird known that has not even a vestige of a wing; the little kiwi itself is almost wingless, and is the only bird known that has its nostrils opening to the exterior at the tip of its long beak; while among the migratory birds the godwit holds the record for long sea flights, for it flies from New Zealand to Siberia and back every year.

However, of late years the bird that has come to the front, owing to its strange habits, is the kea. This mountain parrot (*Nestor notabilis*) is somewhat larger than a pigeon, and its feathers are mostly dark green edged with black, while under its wings and on its tail it is brick red. Its beak is very strong, and the upper mandible very much curved. The bird is confined to the South Island of New Zealand, where it lives among the peaks of the Southern Alps, which often rise from seven to over twelve thousand feet in height. However, it does not by any means always live near the summits of these snowclad peaks, but is most commonly found just about the forest limit.

About thirty-eight years ago, a number of sheep were found torn about in a way that was quite unknown to the sheep farmers, and so a very close watch was kept. The result was that several keas were seen sitting on some sheep and pecking at the wool, and at another time several keas were seen sitting around a wounded sheep. At once the keas were condemned without any further proof, and the slaughter of these interesting birds which was then commenced continues until this day. This was the first and best instance recorded of the keas killing sheep, and when the evidence is sifted there is no absolute proof at all in the record.

This supposed change of an insectivorous and berry-eating bird to a bird of prey has been the cause of a long controversy between station owners and sheep farmers and the scientific men of the colony, who took the part of the kea.

When the writer took up the question in 1905, after reading through all the available records, he could not find one writer who saw the bird kill a sheep, nor was the name and address of any actual eye-witness given. Not only was the fact of the kea's change of habit of scientific importance, but the loss of thousands of sheep made it essential that the question should be once and for all time satisfactorily settled. The writer then set to work, and collected written accounts from men who had actually seen the bird killing and attacking sheep, and the result of this investigation is published in the Transactions of the New Zealand Institute, 1906.

Great care was taken to make the evidence authentic, and in each case the witness had to send in a written statement that he would be willing to swear to his evidence before a justice of the peace.

The reason why so few people have ever seen the kea at work seems to be due to the fact that the killing is mostly done at evening or early morning, at places which men seldom reach until long after the bird has finished its deadly work. Among my correspondents, over thirty men have actually seen the kea killing the sheep. These witnesses do not consist only of musterers and shepherds, but in many instances they are either managers of the sheep stations or the station owners themselves. Summing up the different accounts, which owing to limits of space cannot be published in full here, the birds' mode of procedure seems as follows: They may attack in ones or twos or in numbers, but usually one or two birds do the killing, and the others share in the spoil. The keas always seem to choose the pick of the flock. The bird

"Vegetable Sheep," Said to Account for the Sheep-Killing Habit of the Kea.

settles on the ground near its quarry, and after hopping around for some time, it leaps on its prey, usually on the rump. The movement of the sheep may cause it to fall off, but it persists until it has firmly perched itself on the sheep's back. Then the kea begins its operations by tearing out the wool with its powerful beak, and at last gets its beak into the flesh.

The sheep, which for some time has been moving uneasily about, gives a jump as the beak pierces the flesh, and then begins to run wildly about in vain efforts to rid itself of its tormenter. When, however, the sheep finds it cannot dislodge its enemy, it seems to become terrified with pain and fright, and rushes blindly about, usually at a high speed, the kea meanwhile holding on and balancing itself with outstretched wings. When the beast stumbles, the kea rises on its wings, and settles down again onto the sheep when it has regained its feet. This awful race is continued, until, bruised by its numerous falls, utterly exhausted by its death struggles, the poor animal stumbles to rise no more, and becomes an easy prey to the kea.

It has always been supposed that the kea attacked

THE NEW ZEALAND KEA, WHICH HAS ACQUIRED THE HABIT OF KILLING SHEEP.

the sheep for the sake of the kidneys, and the first man to dispute this, as far as I know, was Mr. F. F. C. Huddlestone. Dr. Alfred Russel Wallace, in his book entitled "Darwinism," after describing the method of the kea's attack, says: "Since then it is stated that the bird actually burrows into the living sheep, eating its way down to the kidney, which forms its special delicacy."

From the evidence of men who have seen many sheep killed and wounded by keas, this statement appears to be erroneous; and of the many correspondents that have communicated with me, only one states that the bird eats the kidneys, and later on, the same writer says: "I have shot many keas by the dead sheep, and they have vomited up fat." It appears as if, even in this instance, the birds eat the fat rather than the kidneys.

One reason why people suppose the kea to be fond of kidneys is that the keas nearly always attack the sheep on the loin, just near these organs. But this may be due to the fact that the rump of the sheep is its widest part, and provides a firm foothold for the kea. Several witnesses say that it is almost impossible for the kea to keep on the sheep's back unless he perches on this part. Furthermore, when flying after a sheep, the rump is the nearest and handiest part to settle on; and as the birds often have to alight on the sheep when it is running, it is no wonder that the rump is the part chosen. It naturally follows that when perched on the animal's hind quarters, the bird will commence to pick the sheep's back at the handiest part, namely, the loin, which is very easy to tear open, owing to the absence of ribs. Even the first recorded accounts of sheep killing mentioned that the birds attacked the loin. I can hardly believe, as some people do, that by some kind of instinct the kea knew where the kidney fat was to be found in the live sheep. This latter idea is somewhat upset by the fact that cases have been seen where the flesh around the backbone has been eaten, and the kidney and the kidney fat left almost untouched.

We now come to the interesting question as to how the kea acquired the habit of killing sheep and eating the carcasses. This can never be completely answered, but there are several theories which are well worth considering, as they throw a certain amount of light on the reasons for the bird's change of diet.

I. The *Vegetable Sheep* theory is certainly the most popular, though it has very little to recommend it. The supporters of this theory suppose that the kea had been in the habit of tearing open the "vegetable sheep," *Haastia pulvinaris* and *Raoulia eximia*, in search of grubs which are supposed to live in these peculiar plants. They are found especially in the northern half of the Middle Island at an altitude of from 4,600 to 6,000 feet, and in external appearance they somewhat resemble a sheep, growing as they do in the form of cushions often as large as sofas, and the whole surface having a woolly appearance. It was supposed that when the sheep first wandered into the kea's domains, the birds mistook them for the wool-like plants, and with the idea of digging out the grubs, they began to tear open the skin of the sheep. In this way the keas are supposed to have acquired the method of killing the sheep and eating the flesh.

This all sounds very feasible, but on further investigation, it is found that the true facts do not support the theory.

1. Where the keas were first known to kill sheep, the vegetable sheep do not exist.

2. There are no grubs in vegetable sheep that are large enough to attract the keas.

3. In places where both the keas and the vegetable sheep are found, the latter is never seen in a torn-up condition.

It seems to me that unless further evidence is forthcoming to support this theory, it must be left out of consideration.

II. The *Curiosity Theory* suggests that the kea, being a very inquisitive bird and fond of investigating anything at all strange that comes in its way, when it first saw the sheep wandering into its domain, at once began to investigate this strange object, and so learned to tear the sheep open.

III. The *Hunger Theory* suggests that lack of food caused the birds to feed on the fat and meat thrown away at the sheep stations. In this way it obtained a taste for meat, and soon became daring enough to attack the living example.

IV. The *Maggot Theory* suggests that the birds first began to eat the maggots found on the dead sheep, and soon learned to eat the meat and then to attack live sheep.

This theory seems to have much in favor of it, especially when we remember that the kea is naturally insectivorous. Again, the very fact that the birds seem fond of dead carcasses rather supports this theory. It is of course impossible to say which theory is nearest the truth, but I think that there is no doubt that the main factors that caused the harmless keas to change their diet and become birds of prey of no mean order are expressed in the last three theories.

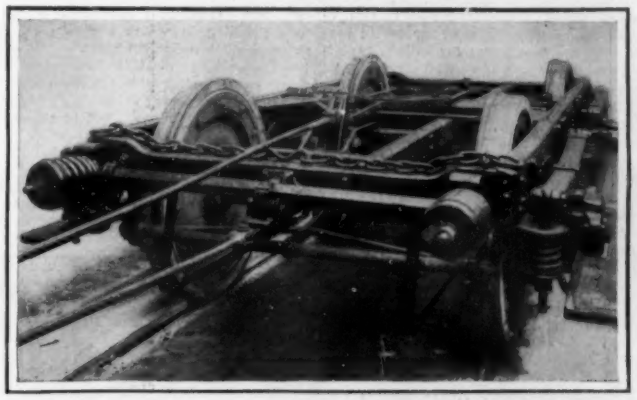
In conclusion, I think that I am justified in saying that, as far as human evidence can be relied on, I have conclusively proved that the kea has not only taken to meat eating, but that it does actually attack and kill sheep for the sake of the meat and fat.

VARIABLE PRESSURE MECHANISM FOR AIR BRAKES.

About thirty years ago, during some experiments with air brakes, conducted by the Institute of Mechanical Engineers of London, it was discovered that the friction between the brake shoe and the wheel is dependent not only upon the pressure applied to the shoe, but upon the speed of the wheel as well, because the same pressure at high speeds will not develop as much friction as it will at low speeds. It is on this account that the engineer must ease off the brakes as his train slows down, else a pressure which could safely be applied to the wheels when traveling at high speed would, as the speed slackens, develop sufficient friction to lock the wheels and produce injurious skidding. With a view to overcoming this defect of the common air brake, a valve mechanism has been devised, which automatically acts upon the air pipe to reduce the pressure gradually.

Our attention has recently been directed to a new solution of the problem, consisting of a mechanism that is operated and controlled directly by the frictional engagement of the shoe with the wheel, varying the shoe pressure without reducing or wasting the air pressure. The coefficient of friction between the wheel and shoe is held at a predetermined constant, regardless of speed or slippery conditions of the wheel. In this way a maximum retardation of the train is obtained at the outset, and the same uniform retardation is maintained until the train comes to a stop. The new brake is called the "Maximus," and details of the mechanism are shown in the accompanying drawings. Each truck wheel is provided with a pair of brake shoes *A* and *B*, respectively operating on opposite sides of the wheel. The shoes *B* are suspended from the truck frame by means of hangers *C*, while the opposite shoes *A* are supported by links *D*, which connect them with the pressure-regulating mechanism, as will be presently explained. The brake beam, which carries the shoes *A*, is formed at its center with a yoke *E*, that extends under the axle and finds support in a pair of hangers *F*. A cam groove *G* is formed in the yoke *E*, which is adapted to receive a roller mounted on the lower end of a lever *H*. The lever is supported at this end in hangers *I*, while its upper end is connected to the brake rod *J*, which runs to the usual brake cylinder. The brake beam *K*, carrying the brake shoes *B*, is connected to the lever *H* by means of links *L*, and to the end of yoke *E* by means of links *M*. It will be evident that when the brake cylinder is operated to move the rod *J* toward the left, the lever *H*, by pressing against the cam *G* and by pulling the link *L*, will draw the opposite shoes, *A* and *B*, against the peripheries of the wheels.

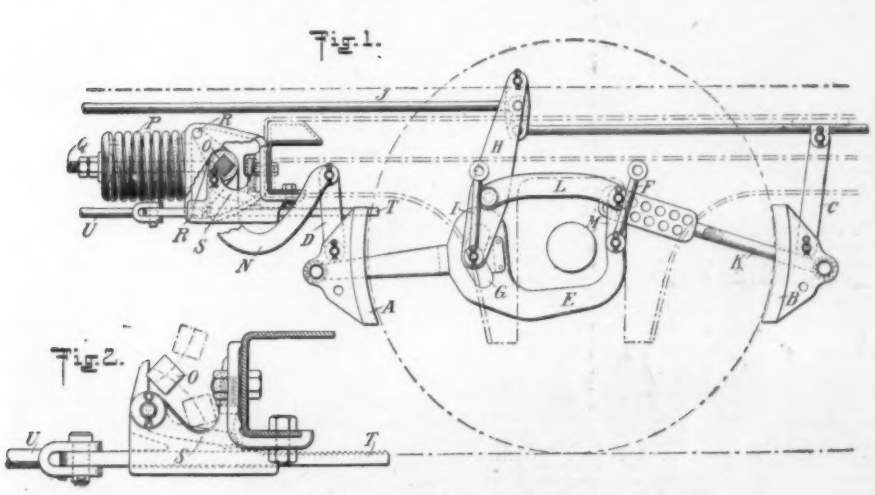
When the brakes are set, the hangers *C* resist the frictional drag exerted on the shoes *B* by the wheels. The links *D* perform a similar office for the shoes *A*, but are not attached to a rigid body as are the hangers *C*, and will yield when the frictional drag exceeds a predetermined limit. It will be observed that the links *D* are connected to arms *N* affixed to a square shaft *O*. The ends of the shaft *O* are inclosed in a pair of boxes carried by the truck frame. A pair of springs *P*, held in compression between the boxes and adjustable heads on a pair of studs *Q* projecting from opposite ends of the shaft *O*, exert a tension on this shaft, which is sustained by the legs *R* formed on the shaft and bearing against the end walls of the boxes. It is these springs *P* which govern the amount of pressure that shall be exerted by the brake shoes on the wheels. If the truck be traveling toward the right, there will be a tendency for the shoes *A* to ride up on the wheels when the brakes are set, thus lifting the arms *N* and swinging the shaft *O* upward on the upper legs *R* as a fulcrum. Should the truck be traveling in the opposite direction, there would be a downward drag on the shoes *A*, tending to swing the shaft *O* downward on the lower legs *R* as a fulcrum. However, any displacement of the shaft *O*, whether upward or downward, is resisted by the springs *P*. By adjusting the heads on the studs *Q*, the spring tension on the shaft *O* may be regulated to any desired degree. Not until the coefficient of friction at the shoes *A* overpowers the resistance of the springs *P* will the shoes *A* be displaced; but with them the shoes carry the brake beam and yoke *E*, and by altering the point of contact of the lever *H* in the cam groove *G*, the pressure of the shoes on the wheel is eased up.



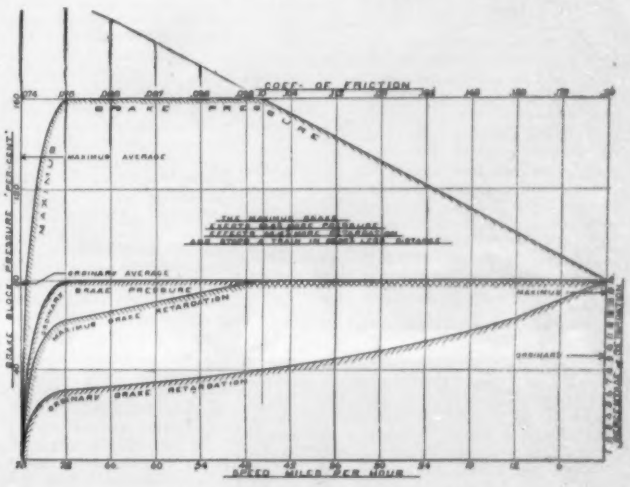
Truck Equipped with Variable Pressure Brake Mechanism.

When this occurs, the brake cylinder is prevented from exerting a higher pressure by the action of a bell-crank lever *S*, as best shown in Fig. 2. One arm of this lever bears against the square shaft *O*, and the arm is adapted to engage the teeth of a rack *T*. The latter is connected by means of a rod *U* with the piston of the brake cylinder. Normally, the lever *S* is held out of engagement with the rack, but when the shaft *O* is swung bodily upward or downward by excessive friction on the brake shoes *A*, the lever is pressed by a spring into engagement with the rack *T*, thereby locking the piston of the brake cylinder.

It will be evident that this mechanism may be made to give any desired minimum or maximum pressure, by adjusting the normal compression of the springs *P*. When the brakes are applied at any speed, they adjust themselves at once to the friction existing at that speed, and reduce the pressure at the shoes as the speed reduces. Skidding is impossible, and there is no danger of injurious shocks. A uniform retardation is automatically effected without imposing any responsibility on the engineer. The brake has been put into actual service on one of the principal railroads of England, and has thoroughly proved its efficiency. It applies a varying force, which is 160 per cent or more of the weight of the vehicle at the commencement of application, and gradually eases off to 80 per cent. A comparison of the improved brake with the ordinary air brake is shown in the accompanying diagram, and it is found that the former exerts nearly 70 per cent more pressure, that it effects 62 per cent more retardation, and that it stops a train in 38 per cent less distance than the ordinary brake.



Details of the Variable Pressure Brake Mechanism.



Efficiency of Improved Brake As Compared With Ordinary Brake.

Soft solder deteriorates. If kept for a long time in a damp atmosphere the metal does not flow readily.

Investigation of Steel-Hardening Metals.

So many investigations have been carried on in connection with the manufacture of crucible steel and of high-speed tool steels that further advance in this direction would seem most improbable, but the combination of other metals with steel has now fully shown that they give it specific properties that adapt it especially to particular uses. The known steel-hardening metals, in the order of importance of production and use, are nickel, chromium, manganese, tungsten, molybdenum, vanadium, titanium, cobalt, and uranium. The value of these metals produced in the United States in 1906 amounted to $458,327, of which $393,667 was for tungsten. The price of tungsten, which has been increasing for a number of years, was quoted at $5 to $6 per unit (1 per cent of a ton) in 1905, and at $12 per unit in the spring of 1907. Only small quantities are at present imported into the United States, as European markets utilize practically all that is produced in foreign localities, mostly in Peru and Australia. Large deposits of tungsten are found in Australia, and it is not improbable that sufficient may be obtained there to permit a certain portion of it to be shipped to the United States, but for the present this country will have to look within its own borders for sources of supply.

The increased demand for the steel-hardening metals has stimulated prospecting for the ores in the United States, and information concerning them is eagerly sought. So many inquiries have reached the United States Geological Survey that a special investigation of the subject has been planned, which has been assigned to Frank L. Hess. In the course of this work, which will extend throughout the summer and into the fall, Mr. Hess will visit South Dakota, Idaho, Colorado, Montana, Washington, Oregon, California, Nevada, Utah, and Arizona. The results of Mr. Hess's work will be reported in a bulletin on the steel-hardening metal deposits other than manganese.

Right to Use the Name "Chartreuse."

After a long litigation in the English courts the Carthusian monks have lost their case in an action which they brought to restrain the use of the name "Chartreuse" in connection with the sale of liqueurs in England. The monks were expelled from France in 1903 and their business of La Grand Chartreuse was continued by a French government sequestrator, against whom the action was brought. Justice Sir William Joyce, in the High Court of Justice, in delivering judgment said that after the expulsion the sequestrator became entitled to the business of La Grand Chartreuse, including the distillery and its assets and good will. The business now conducted by the monks at Tarragona, in Spain, was not legally the old business or a continuation of it. The defendant had not made any misrepresentations regarding the liqueurs he manufactured. The monks' action was therefore dismissed, with costs.

An effective bactericide is announced by Messrs. Paterno and Cingolani, who have found that one-half grain of silver fluoride in a quart of water effects complete sterilization. Experiments were made with complete success on sewage water infected with various injurious micro-organisms, including those of typhoid, diphtheria and cholera. In each case sterilization was complete and permanent. Fluorides are reputedly very poisonous, but dogs given food containing a small quantity of the preservative showed no ill effect.

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTROMAGNETIC SOUNDING APPARATUS.—W. F. SEIDEL and E. SASSENHOFF, Elkhart, Ind. The invention relates to apparatus capable of general use but of peculiar service upon automobiles, motor-boats and the like in which it is desirable to sound signals at will. It may be operated by direct or alternating currents, and employed as a horn or whistle, and operated by hand or foot. It is easily regulated and admits of a variety of uses.

Of General Interest.

MAILABLE BLOTTER.—G. W. SPEYER, Philadelphia, Pa. The object of the invention is to provide an article, one portion of which comprises a blotter and the remaining portion adapted to carry any desired amount of advertising matter and also the name and address of the person to whom the article is mailed. On arriving at its destination, the advertising and address sections may be torn off, leaving the blotter perfectly clean and fresh for use.

PICTURE-HANGER.—H. N. PATRICK and G. T. OGLESBY, Sheffield, Ala. In this instance the invention is an improved means for hanging or suspending pictures from walls. It provides for easily and quickly raising or lowering as required, and for locking at any required height. The rim of a disk is bent outwardly to provide increased space for the cord when wound on the pulley.

FENCE-POST.—A. M. WEATHERLY, Sr., Rome, Ga. The object of the invention is the provision of a double metal post which may be manufactured economically and is rigid and durable in use. It is adapted for use of boards, pickets, or wires comprising the body sections or portion of a fence, and may be used in line as a part of the fence proper, or as a corner therefor.

STOVEPIPE.—J. MCGHIE and B. BLOOD, Spokane, Wash. The invention is an improvement in stove and other pipe-joints and has for an object to provide a simple construction which can be easily made and which will effectually and safely couple the pipe sections so they may be conveniently detached. In practice the sections may be made with projecting hook-like tongues at one end and the beads at the other end for convenience in fitting the sections together.

DINNER-BUCKET.—J. J. BURNS, Cumberland, Md. In this patent the invention is an improvement in dinner buckets intended especially for working men and others who may desire to take dinner with them, and for heating the different articles. The bucket will be found useful by hotels and restaurants for sending out hot dinners.

DEVICE FOR TEACHING PENMANSHIP.—L. G. MCCONACHIE, Madison, Wis. In the ordinary school copybook used in teaching penmanship each page contains an engraved headline or model and a dozen or more lines underneath upon which the pupil endeavors to reproduce the copy. The inventor's object is to overcome the above objections by providing a simple and compact article of novel form.

MEASURING DEVICE.—G. F. CLARK, Tower, Minn. The object of this improvement is to provide in one compact implement, convenient for use, a board or log rule of suitable length, a short scale to take the thickness of plank or boards, and a pencil holder and a chalk holder for respectively tallying the material as measured, and for marking the area or cubical contents of boards or logs, respectively, as they are measured.

PHOTOGRAPHER'S TRIMMING-WHEEL.—L. F. SMITH, El Paso, Ill. This improvement relates to trimming wheels, that is, a device having rotary cutter, as employed by photographers for cutting photograph prints, and similar material, into circular, oval or other shape, and at the same time when desired, leave a marginal border around the picture or print, of contrasting color or tint.

Machines and Mechanical Devices.

WOVEN FABRIC.—J. K. DALKRANIAN, New York, N. Y. The object of the invention is to provide certain improvements in selvages for fabrics, notably woven pile fabrics of the oriental rug type. The invention consists essentially in a selvage having a selvage ground warp, and a selvage binding warp interwoven transversely with the said selvage ground warp and interlooped with the binding weft of the woven fabric.

ENVELOP-FORMING MACHINE.—W. L. BARSTOW, Vicksburg, Miss. The result aimed at in this invention is the production of a machine which is adapted to be used for the purpose of forming envelops about a circular or letter which is to be sent by mail; the arrangement being such that the envelop will be formed and sealed at substantially the same operation. It will be useful in large offices where a great quantity of mail is sent out.

SHAFT-KEY.—W. E. LAUDERBAUGH, Utica, Ohio. The invention consists in providing the main body portion of the key with a reverse taper, that is, instead of tapering from the head end of the key to the point end, it tapers back from the point toward the head end. A wedge is placed upon the tapered side of the main body and means are provided for holding the key and wedge in a predetermined position. The key, when assembled for use, is slightly larger toward the head end so that it can be driven tight in its seat.

FEEDING-HOPPER.—A. JOHNSON, New York, N. Y. The improvement pertains to hoppers for feeding metal crowns or caps for bottles or other articles having inclined walls of gradually increasing diameter, to an assembling table. The object being to provide a device so constructed as to direct and deliver the articles open side, or right side upward, for receiving cork disks therein, thus obviating the necessity of manually turning the crowns, therefore saving considerable time in the assembling of parts.

Prime Movers and Their Accessories.

FEED-WATER HEATER.—M. L. CABLE, Greensboro, N. C. The invention relates to water heating systems designed for use in connection with the feed water for boilers, radiating systems and the like, in which exhaust or waste steam from an engine or the like is utilized for the purpose of heating water, the steam and water being combined in a heater before being supplied to the feed pipe connected to the boiler or other device. An object is to get the greatest possible temperature in the feed water with the least amount of steam.

WATER-PURIFYING APPARATUS FOR FEED-WATER IN STEAM-BOILERS.—J. JÖRGENSEN, Baldersgade 8, Copenhagen, Denmark. In the present patent the invention is an improvement in purifying apparatus for feed water, and relates especially to that class of purifying apparatus wherein the feed water is mixed with lime water contained in a tank or vessel, the lime water being supplied to the feed water at definite intervals.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

FIGHTING SHIPS. Founded and edited by Fred T. Jane. London: Published for the Naval Syndicate by Sampson Low, Marston & Co., Ltd., 1907. Price, $8.50. Oblong 4to; pp. 495.

The 1907 edition of Jane's "Fighting Ships" is marked by the accuracy and completeness which have given to this annual its widespread popularity, and there are certain new features added which greatly enhance its value. The principal addition is the treatment of merchant ships, photographs of which have now been given a national arrangement, while at the end of each of the principal navies are placed all liners which are likely to have some war use as scouts, etc., or which are subsidized. Silhouettes of these merchant ships have also been added. Even greater in value is an addition at the end of the book which includes in a specific scheme all merchant ships that are at all removed from the "tramp" category. The first part of the volume consists of an illustrated description of each navy of the world, over 400 pages being devoted to this feature alone. The information regarding each navy comprises, first, diagrams of the various flags; maps of the leading shipyards with tables of the docks, building slips, etc.; a list of private docks and yards, giving their sizes and capacities; a complete set of identification and signal silhouettes of the ships of the navy, from battleships down to torpedo boats, followed by excellent silhouettes of the leading liners; tables of the types of torpedoes used, giving their principal dimensions, speeds, etc.; and tables giving full details of the naval guns employed. This is followed by a tabular description of each ship in the particular navy treated, containing all details of guns, armor, size and speed of ships, etc. With this is a side elevation and plan, showing by shading the distribution and thickness of the armor, and also, where possible, a half-tone engraving of the ship is presented. Part II. contains a series of chapters on leading topics of interest affecting naval development, written by well-known experts on the various questions considered. There are tables giving a list of the warships of the world that are fitted with turbine engines; others showing ships carrying heavy armor-piercing guns; ships with waterline belts, and the ships with waterline belts safe against various types of guns outside of 7,000-yard range. This annual has become the standard work among naval authorities; and it will prove a source of continual interest and information to that increasing circle of civilians who follow closely the progress of naval development.

CLINTON WIRE LATH. Descriptions, Specifications, Applications. Clinton, Mass.: The Clinton Wire Cloth Company. 8vo.; cloth; 50 pages.

Although an advertising booklet published by the Clinton Wire Cloth Company, of Clinton, Mass., it contains a great deal of valuable information as to the use and possibilities of this very efficient building material.

PITMAN'S DICTIONARY OF COMMERCIAL CORRESPONDENCE. In English, French, Spanish, and Italian. London: Isaac Pitman & Sons, Ltd., 1907. Cloth; 12mo.; 502 pages. Price, $2.25.

A very excellent and serviceable work for those having commercial relations with foreign countries.

PRECISION GRINDING. By H. Darbyshire. New York: Hill Publishing Company. 162 6x9 pages; 39 illustrations; 3 tables. Price, $2.

The author of this book, who is a well known contributor to the columns of the American Machinist on grinding and kindred subjects, sets forth in this volume some valuable information which should be of service to users of grinding machines in general. He deals briefly and to the point with the advantages of grinding, describes various classes of grinding wheels and methods of making and grading them, discusses speeds and feeds of wheel and work and the effect on output and quality of finish, of coarse and fine grits, hard and soft wheels, broad and fine side feeds, etc. One chapter is devoted to plain cylindrical grinding and another to plane surface grinding in which the use of the magnetic chuck is taken up along with other matters pertaining to this line of operations. Some causes of defective work such as temperature, improper methods of chucking, poorly fitted arbors, etc., are treated in a way that should make this section of the book especially useful to grinding-machine operators. The last two chapters of the book are devoted to laps and lapping, and measuring tools and gages, both of which subjects are of importance in connection with the finishing of precision work.

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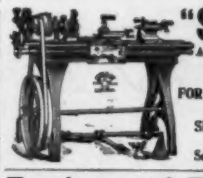

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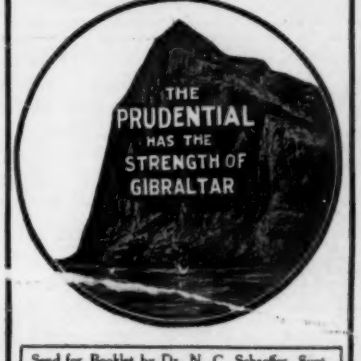

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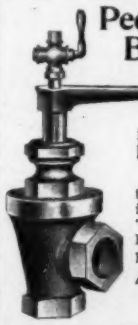

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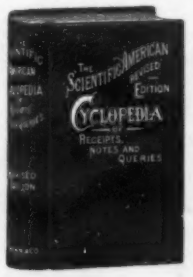

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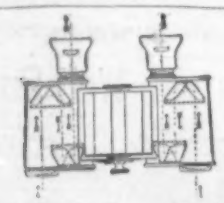

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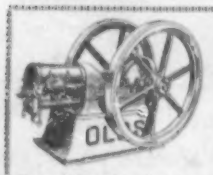

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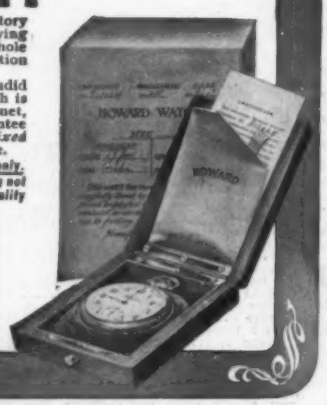

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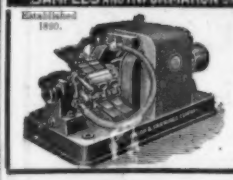

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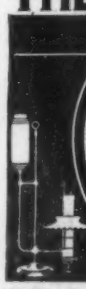

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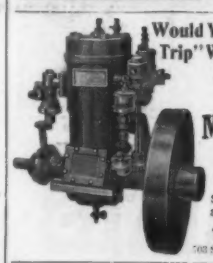

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